

OCULAR ORIENTATION

A SUPER-FACULTY
OF THE EYES

HAZEN

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A MONOGRAPH

on

Ocular Orientation

A Super-Faculty of the Eyes

The Pilot of our Life-Giving Jaunts
The Dependence for Efficiency in Obtaining a Livelihood
The Spirit of the Initiative
The Ultimatum of Professional Research and Skill

By

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INTRODUCTION

OCULAR ORIENTATION

A function of the human eyes regulated and controlled by the extrinsic muscles; the pilot for guidance in perambulations and the principal dependence in gaining a livelihood.

Having practiced ophthalmology very close to fifty years, mostly in Iowa and that half of that time I practiced the particular treatment from which I have deduced the subject of this book and its bearings to ophthalmology, I believe it to be of great value in this branch of medicine, I am loth to let the idea and the experience go to waste.

I have determined to put it into this form while I am able for the good of the profession to which I owe much, and for the benefit of the many sufferers of complaints with the very prevalent diseases connected therewith.

I deem it not out of place here to mention (with some apology) that during the whole period of twenty-five years as mentioned above, in which I prosecuted this work, I was ill with gall-stones, but was not aware of the cause of my debility, but in 1913 the cause was relieved by a successful operation, which restored me to health, but I left my field of practice and came to California to recuperate.

For the last nine years I have done but little in the practical development of my principles, but in 1920 I furnished two articles upon the development of these prin-

ciples which I have derived from my experience in treating the ocular muscles. These were published in *The Archives of Ophthalmology*, New York, Putnam Sons, publishers. In 1921 I contributed an article to *The Physiological Optics*, Southbridge, Mass., and another article to the same journal, not yet published.

In 1911 I published a second edition of a work on the subject, entitled *New Findings in Ophthalmology and Otology*.

In the early '90s I had made a model of an instrument which I thought embodied the principles I considered necessary to treat the ocular muscles for weakness. This model was in my office seven years, unused, I having not yet established recognition of the conditions of the eyes needing this treatment, but which I found, afterwards, in many cases all around me, exceedingly prevalent.

Upon finding the principles correct and the treatment efficacious, I had made a number of instruments which I named Kratometer, and introduced them and gave correspondence instruction in their use.

As this book is written for the profession, and as always in instruction I have given, required of my students a full knowledge of the anatomy of the parts and a familiar experience in the art of refraction, I will assume that in my dissertation here upon my theme, these subjects would be out of place. If there is any necessity for some knowledge of the elementary subjects to understand the text, there are many works that will inform better than I can.

The theme of this book is Ocular Orientation, a function of the eyes; its identity in ophthalmology. Second: Asthenopia is a pathological condition of the muscles which control this function. Third: The remedy for this disease is the treatment of the muscles by use of prisms.

Strange to say, this function has not been made an entity in ophthalmology!

A consultation with Dr. E. L. Holmes of Chicago in 1896, in a case that broke down in her studies while in a college in Iowa, for whom I had refracted twice, but did not relieve, wherein the Doctor found nothing but "weak muscles." This started me on the road to put in practice what I had visualized. Whereupon the model I had almost forgotten, was at once put in use and brought surprising results. She was at once made whole.

From this incident I instituted examination of others, and found a high percentage of students in the university in which I was a clinical professor suffering from this trouble.

On the examination of many treatises and textbooks that sprang into life on the epoch that Donders created with his *Accommodation and Refraction* fifty years ago, and seeing the rich field connected with the function of orientation lying fallow and unappreciated, I wondered at the situation and was convinced that there was much yet to learn in our science.

If I do not succeed in establishing the fact that this binocular apparatus and its anomalies, is the most important division of all the sub-divisions that are made of the subject of ophthalmology, I will have either to mourn over my inability of description or prepare for the consequences.

I must, before setting out on this task, *box my compass, and prepare* to intimately describe my mysterious function, for I have been officially informed from the *Journal of the American Medical Association* that my paper on *Ocular Orientation*, a function of the Eyes submitted to them and afterwards published in *The Archives of Ophthalmology*, N. Y., "that not five percent of the readers (of the journal) would understand the article, it would

be entirely beyond them." This must be my explanation for the "gatherings" I expect to make in my attempt to habilitate my subject, which for some, will be thought superfluous.

Orientation—This word is not a familiar one in our vocabulary. Let us pause awhile and study this word; its history; its metamorphosis in the several meanings in which it has been used and note the peculiarity of its utilization, viz.: *the finding of the place of humanity in the physical universe.*

It is a curious example in philology. It may be interesting to us as scientific ophthalmologists that our specialty, which claims to be nearer an exact science than any other branch of medicine, that we have a word which has come down to us in a scientific line from the days of the beginning of scientific thought in the world, and as now used to convey to those of our day, a mechanism that works so mysteriously in our economic existence.

1st. It dates back to the dawn of scientific thought in the world, 3,000 B. C. when the priests were the only educated class of mankind. It is the name given to the idea, plan or principle of building of the Temples so as to face the rising sun of March 21st and September 22d. The pyramids of Gezah are orientated, and the Sphinx faces due East. The Temples of Babylon were so built. This custom of orientation was followed by builders of Christian Churches in the Middle Ages. It is found in the Greek Temples, Stoneage—*Wells' Outlines, Vol. I, p. 238.*

The object of this facing in olden times was that the first rays of the sun should strike through the doors of the temple and shine upon the shrine or god here placed in the vestibule.

The second use of the word orientation, is given to the instinct observed in animals, which enables them to find

their situation and relation or bearings to the place and the direction they wish to go. This is highly developed in the well known "homing pigeon." The instinctive behavior shows itself distinctively in other animals; the domestic cattle, after an all-day wandering, will turn at nightfall, and go towards home where they are herded for the night. Man has this faculty in a certain degree; some are never at a loss to find their bearings, while others in a strange city are completely "turned around" and have to depend upon an intellectual faculty to learn location.

The third use of the word is curiously applied to a function presided over by the bin-ocular moving apparatus in adjusting the two eyes upon an object looked at, so that the object seen by each eye may be fused into one.

This function measures distance, relation of objects to ones self, and to each other; its bearings gives appreciation of space; an estimation of form, contour, symmetry and curve, thickness, depth and configuration. It also measures speed of an object to or from. Notwithstanding the difference in the use of this word, may we not see in all of their applications a method of adapting the physical well being to the material existence of the universe?

A more comprehensive description of this function will be taken up in Chapter IX.

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CHAPTER I

AN EARLY HISTORY OF THE RISE OF OPHTHALMOLOGY,
DOWN TO AND INCLUDING PROFESSOR DONDERS' SYSTEM OF
"ACCOMMODATION AND REFRACTION". THE PHYSICISTS;
THEIR CONCEPTION OF EYESTRAIN.

There must be some knowledge of the conception of an idea previously held to perfectly understand the new phase of it when presented for our consideration. I will therefore briefly scan the opinions held in the generation passed in the nineteenth century.

I quote from Professor Flint's *Physiology* (1876), p. 802. "In normal binocular vision the images are formed upon the fovea centralis of each eye; that is upon corresponding points, which are for each eye the centres of distinct vision."

"It is hardly necessary to speculate with regard to the reason why the two images, one upon each retina convey the impression of a single object, * * * We shall see, however, that the concurrence of both eyes is necessary to the exact appreciation of distance and form; and when the two images are formed upon corresponding points, the brain receives a correct impression of a single object. * * * It is undoubtedly true that education and habit have a great deal to do with the correction of visual impressions and the just appreciation of the size, form, and distance of objects."

He had not attained to the doctrine of *fusion*. The muscles of the eyes are to move balls, simply.

I know of no greater eulogy upon the eyes, or a better portrayal of the subject to that date, than Helmholtz's description of the eye, in his lectures in 1868. There has been no man living, who has added more to the knowledge of the eye in a single generation than Professor Helmholtz.

"The eye," he says, "has always been held the choicest gift of Nature—the most marvellous product of her plastic force. Indeed, the most enthusiastic admiration of this wonderful organ is only natural when we dwell on its penetrating power, on the swiftness of successions of its brilliant pictures and on its riches which it spreads before our senses.

"But even more important than the delight in beauty and admiration of majesty in the creation which we owe to the eye, is the security and exactness with which we can judge by sight of the position, distance and size of the objects which surround us. For this knowledge is a necessary foundation for all our actions, from the threading of a needle through a tangled skein of silk, to leaping from cliff to cliff, when life itself depends on the right measurement of the distance.

"In fact the success of the measurements and actions dependent on the accuracy of the pictures that it gives us, forms a continued test and conformation of that accuracy."

But Helmholtz has not in this beautiful lecture, explained the workings of this binocular apparatus, or attributed the power that measures distance by the function that fuses the two pictures into one.

We further extract from his lectures on the *Theory of Vision* in which the theories of the day were discussed. He rejected what was the "Intuition Theory" in which was the doctrine that the two pictures received by the two eyes were united in the brain.

He adopted the "Emperial Theory" of excitation. He says: "This conception of differences in locality, can only be attained by means of movement, and in the field of vision, depends upon the experience of the movements of the eye * * * while we have two retinal pictures we do not see double * * * both retina when they are excited produce only a single sensation in the brain * * * when we move our eyes while looking at a field of vision filled with objects at rest, the retina as it moves, changes its relation to the almost unchanged position of the retinal picture. We thus learn what impression the same object makes upon different parts of the retina. An unchanged retinal picture, passing over the retina as the eye turns.

"The Emperial Theory" does not assume any peculiar modes of physiological anatomical pictures.

"It is true that we cannot, at present offer any complete scientific explanation of the mental operations involved, and there is no immediate prospects of our doing so."

I do not mention these shortcomings of Helmholtz to criticize him. I would not upbraid him any more than that he intended to reproach Nature when he points out the defects of the eye as an optical instrument, when he says: "that he has not done so in order to depreciate the performance of this wonderful organ, or diminish our admiration of its construction. It is my object to make the reader understand."

It is a good example of *authorities* in the progress of ophthalmology in his generation, and that however brilliant his generation, there is room for generations yet to come.

The service of ophthalmologists in early times, not further back than the span of years of some now living, was to cure the many diseases of the eye which were mostly inflammations.

When the system of Anomalies of Accommodation and Refraction of Prof. Donders' of the University of Utrecht, early in the '60s came into the world it revolutionized the science, and revealed the fact that errors of refraction were a fruitful cause of inflammation in a vast number of the troubles with which this organ is afflicted.

Physicists have contributed to the work of ophthalmology: Thomas Young, as astigmatism; Helmholtz, the ophthalmoscope; and in the early days before Donders' spectacles were sold by opticians.

It is no wonder that we find in ophthalmologists so strong a tendency to look upon the eye as being a human machine, needing repair and that they have held this view of asthenopia; the characteristics of mind of the physicists who are trained in the laws of energy and matter and have been imparted to medical men and others who practice this science. They place too much dependence on the mechanical method of dealing with this organ and overlook the physical or biological explanation of the problem.

I would not detract in the least from the great boon the system of Donders has been to the world in relieving many optical anomalies, making better vision and relieving painful symptoms connected therewith.

There will always be the need of this service, and people will be made better by it in a large percentage in our community. The prejudice against wearing glasses, that we had to contend with years ago, is done away with and it has become quite fashionable, and business has been built up on the propaganda that supports an army of glass fitters who correct an infinitesimal amount of error of refraction that can not be of any benefit. So there is a great exaggeration of this service, and much false doctrine and ignorance of the real inability to the eyes.

Asthenopia was a word brought down by Donders from his predecessors which included all the painful and disagreeable symptoms with trouble in the use of the eyes.

The description of these asthenopic symptoms as given by him, are exceedingly vague, and do not lead to any thought of physiological nature: "morbid condition of the eyes," "dimness of vision," "affection of the retina from excessive employment," "disposition to fatigue," "slowly adjusting sight," "inability to perform the uses of the eyes." "However," he says, "the phenomena of asthenopia proceed from nothing else than from fatigue of the muscular system of accommodation," which is the keynote of the system. This is the dynamo-mechanical explanation. He tries to locate the trouble in the retina.

The word eyestrain has been coined in later years, and seems well fitted to that class of cases which need the attention of the refractionist.

We have a better application of the word "Asthenopia" which has been used to designate the pain or discomfort in use of the eyes in general, which will be fully discussed further on.

Now at this point I deem it appropriate to place here in conjunction with the symptoms enumerated by the physicians, a remarkable collection of expressions in describing symptoms from which the writers suffered, collected by Dr. Geo. M. Gould, taken from letters of notable men and women who have been using their eyes severely, and were more capable of description than the average, who devote their lives to literary work.

The Doctor attributes this suffering to the inattention to the anomalies of the intrinsic apparatus, whereas my experience with the treatment of the extrinsic muscles for similar symptoms, leads me to believe that these people had troubles of ocular orientation.

There are symptoms, as every oculist knows, that are

described by "eyestrain" patients, only by pantomime, which are impossible to be put into words, and which are pronounced "horrible" or "inexpressible" and end with the remark that they "hurt." We owe much to Dr. Gould for his excerpts from the writings of literary men and women who have figured so largely in original thought and whose products have been cut short by unrecognized disease, thereby emphasizing the importance of this particular disease in the economy of men. These of all persons are best able to set forth their feelings and sensations and thus add to our symptomology.

There are fourteen of them: DeQuincy, Carlyle, Mrs. Carlyle, Darwin, Browning, Huxley, Wagner, Parkman, Whittier, Herbert Spencer, Margaret Fuller, George Henry Lewes, George Eliot and Nietzsche.

First. *Eye ball.* The most common appearance is redness of the ball or lids and is an indication of disturbance. The eyes may be intolerant of light. The balls soon grow dull and lose their luster and there is an avoidance of fixing them; the eyes are soggy and sometimes turn out. This condition is illustrated in portraits of Darwin, DeQuincy, Carlyle, Huxley, Wagner and Whittier. Parkman had intolerance of light, and became so blind he wrote with a "gridiron," a contrivance that did not require sight to follow the line of writing.

Second. *Head and nervous system.* Headache from the region of the eyes to encompass the whole head, spine and limbs; and a general derangement of nervous system and reflected upon the organs, sometimes quite remote. The effect on the intellect and disposition is often marked. DeQuincy said "hideous sensations begin to haunt me as soon as I fell asleep." Carlyle had "stupidity," "sickness of mind and body," "hypocondria," "head full of air." Darwin had "great prostration of

strength," "reading makes head sing," "neurosthenia," Huxly, "hypocondrical and bedeviled," "voiceless," "lassitude and depression," "unaccountable prostration." Browning had "vertigo," "dizziness," "noise and slight turning," "physical apathy," "haziness." Parkman had insomnia, and insanity was feared by his friends. Spencer, insomnia, "queer feeling in the head." Wagner, "shattered nerves," a martyr to "sick headache." Whittier was continually "out of sorts." Nietzsche had at the end "atypic paralysis," inability to sleep was common to all of these fourteen cases; some but two or three hours sleep for weeks at a time.

Third. *Affecting the digestive system.* Generally after head symptoms come, probably, the most distressing symptoms, the hideous "sick headache," with which all the fourteen were more or less afflicted; irritation of the stomach, "derangement of the liver," "lack of appetite," "famishing," "gnawing at the pit of the stomach," "constipation," "nausea," "vomiting," "flatulency," "biliousness." Darwin's father was a physician, could not explain the symptoms of his son in the many severe attacks he had, and we got no jumble of English expression from him in this connection, but we get it from DeQuincy's physician, who said he suffered "from a terrible and distressing affection of the gastric nerves called gastrodinia." Carlyle's physician housed him in his own home for a month to study his case, and wanted another month, after he had pronounced it dyspepsia. In Browning's case his physician called it "heredity" and "neuraesthesia." Parkman was diagnosed, "affection of the brain." Mrs. Carlyle is said to have had "climatic melancholia." Huxley, himself a graduate of medicine and a teacher of physiology, considered his case a mystery. Parkman, an athlete in his younger days, had a highly irritable organization, which drove him out on the "Oregon Trail"

and on return to work he suffered severely and became almost blind and got no relief from oculists or from the fitting of glasses.

Habit and Character. Besides the specifically local symptoms, we may note the injurious effect this affliction had on the habits and character of these noted people. In some there was a most painful lassitude and exhaustion, while in others an over wrought activity. The effect on the general system, we have noted, often comes suddenly, like cyclone, after a use of the eyes, but while at work there may be no distress in the eye or body. But Carlyle worked with his "nerves in a blaze." It "stirred up" Parkman and produced irritability and pessimism. In many there was a helplessness and despair, and a fear of immediate dissolution, but there being no organic diseases, most of them lived to a great age, and by dropping their work at intervals and taking jaunts, they recovered from their distressful lives only to suffer again on return to near work.

It is very pathetic, that so many of the characters who have a world-wide reputation for their contributions to the thought of their generation, should be prostrated by such physical agony; and again, the associated thought, of what these people might have done had they had good eyes, or if they could have been made so by medical skill. It is a sad thought that the science of medicine in their time was not able to adjust their eyes to the requirements of their ambition.

Misapprehensions. DeQuincy resorted to opium until the quantity used rose to 340 grains a day. Carlyle's indigestion caused him to take castor oil by the "stupeful;" three weeks without sleep. Darwin passed forty years without a well day; his sea-sickness was terrible on the "Beagle." He and Wagner resorted to Hydropathy with some temporary benefit.

Among the curious phenomena that produce asthenopia is the demand for exercise. All of the fourteen patients exercised to an unusual extent. DeQuincy walked at night in a circle, about ten miles a day; the same by Darwin. Huxley, from ten to sixteen miles a day. Carlyle rode 2,000 miles on horse back. When they were not driven away from home by the advice of their doctors, to climb the mountains and walk the moors, they tramped and paced their beaten paths by night and by day, until from weariness they could sleep. This is pitiable when we know that to a well adjusted organism, a half-hour a day of vigorous exercise is sufficient to keep in good condition. Eyes in healthy condition and adjusted as they should be, may be used ten or twelve hours a day without danger.

It is the conviction of the author that cases afflicted as here detailed belong almost exclusively to anomalies of the muscles of the eyes, and that very little, if any benefit, towards the removing of this kind of asthenopia can be gotten by correcting the error of the focal apparatus.

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CHAPTER II

THE DEVELOPMENT OF THE IDEA OF THE EXTRINSIC MUSCLES BEING IN THE PROBLEM OF ASTHENOPIA— "MUSCULAR ASTHENOPIA"

The first attempt, as far as I am aware, to regard asthenopia a pathological disease was that of Dr. E. Dyer, of Philadelphia, in his paper: "*The Morbid conditions, functional and organic, included under the name of Asthenopia,*" at the American Ophthalmological Society, at its meeting in 1865 in New York City. The all sufficient faith in the doctrine of Donders got a great jolt. It was the dawn of training the eye muscles, and had here its first inception. He reported a number of cases where there was no Hypermetropia, either latent or apparent, with accommodation good; no indistinct reading, but with absolute pain in the eyes, with sensations so disagreeable that the patient ceases to use them; rest for an hour did not relieve; pain lasting generally for hours; some intolerance of light; can bear the light if excited, and can often go to the opera or party without discomfort at the time, but the next day or two, they suffer the penalty. This condition he found in persons under thirty years of age. The ophthalmoscopic appearance was not well marked or constant; generally nothing abnormal. Frequently the optic nerve was "dirty"—that is, was not clear and also the choroid streaked.

The portraiture of this class of cases at the first was as accurate, as I have since observed them, showed a

wonderful discriminative insight. Dr. Dyer was led to the conclusion "that there was some trouble with the accommodation." His inquiry was a very natural one: "Why is it that accommodation, convergence and torsion do not bear their proper relation to each other? and Why is there obstruction?"

His remedy was a discipline by gymnastics at the near point; putting on a convex glass which he said "changed the relation of the accommodation."

About the time Dr. Dyer's presentation of his system for relief of accommodative disability, von Grafe had evolved the idea of "insufficiency of the interni," and Dr. Noyes in discussing the subject (who was present at the meeting of the American Ophthalmological Society spoken of above) mentioned the necessity of definite tests of these disabilities under the head of Asthenopia, trying to make a distinction clear between "disability to keep the dioptric system on the visual lines," "hyperesthesia of the retina," and also proposed examinations of the extrinsic muscles, and other tests, which stripped off much of the mystery surrounding the subject. He told his experience in the use of prisms in spectacles. He gave examples of cases of intolerance of light, and so far as I know, was first to attribute this condition to asthenopia. He materialized the subject and brought it down onto a scientific basis.

During the interval from this time to the meeting of the International Ophthalmological Congress of 1876, he accomplished much in differentiating accommodative and muscular asthenopia, and his paper at that Congress was greatly in advance of the general thought of the time on that subject.

Dr. George T. Stevens of New York has published several works in the line of development of the Muscles of the Eyes, systemizing and illustrating the principles

upon which the anomalies of the "Motor apparatus of the eyes" depend. There is much original work in this conception, and he gave us, in 1894, a complete nomenclature to be used in descriptions of deviations of the eye axis, which has been universally adopted.

Dr. A. L. Ranney, a nervous disease specialist of New York, who published several works, was a close follower of Dr. Stevens. These men put their faith in "Graduated Tenotomy," for the correction of these anomalies; the mechanical method, the process of the Physicists.

It is now about two hundred years since the commencement of Tenotomy of the muscles of the eyes. Dr. Stevens in his work, *Motor Apparatus of the Eyes*, gives a full history of tenotomy of the muscles, from which I gather few facts of early history regarding them.

Dr. John Taylor, at the beginning of the period, made a great sensation in operating upon the interni for strabismus. He did not scruple publicity and his work was considered a wonderful feat. Although he was a well educated man, the profession dubbed him a quack.

When we consider the field which he had all alone, and that he had no anaesthetics and probably poor instruments, as compared with ours, he is deserving of much credit.

This operation soon after him became disreputable. A hundred years after (1839) Duffenbach, of Berlin, followed Professor Stromor's principles in orthopedics, of severing the connected muscles. He made known the steps of the operation on the eye. His operation soon became unpopular, it is said from the practice of severing the muscle several lines back of its insertation to the ball. von Grafe revived by recommending the division of the muscle close to the sclera. This is the prevailing operation, improved by Critchett of London.

With the exception of Prof. Donders' method of cor-

recting strabismus convergence by correcting the Hypermetropia, the operation has free course improved by Critchett of London and later by Dr. Stevens of New York, the operation stands approved in the profession, even today.

In regard to tenotomy in strabismus *divergence*, there is much less consensus of opinion as to its utility. Indeed it is resorted to with reluctance and it is performed for "cosmetic reasons," and then the surgeon expects a good deal of trouble afterwards.

As an example of the tenacity with which those dealt with the class of cases, called asthenopia, held the mechanical method, even as high an authority as Von Grafe, is worthy of note. He called it "latent strabismus" or insufficiency (which we mentioned before). In cases of high degree of myopia, wherein drawing the eyes on the median line for reading and one or both eyes would deviate, Dr. Stevens says von Grafe's writings on this condition does not intimate that the interni were weak, but that "greater than normal tension was required of the internal recti, and they were insufficient for the unusual task." He speaks of the contraction excess required to induce the proper convergence; not the contracting weakness; *Motor Apparatus of the Eye*, p. 14. In this then there is great confusion of definition, or special pleading. Dr. Stevens regarded insufficiency as a cause of asthenopia.

Von Grafe employed prisms, base out, but preferred the more radical method of dividing the external. "He was willing," says Stevens, "to sacrifice single vision at the distance, causing homonomous diplopia by the operation," p. 15. *He converted heterogenous conditions to homogenous*. This is mechanics at the limit, strabismus at the distance in order to read at the near.

Dr. Stevens developed a different procedure. He

sought equilibrium of all the muscles but he did it with hook and scissors. No doubt Dr. Stevens, by his work and publication has established, as a law, that our object should be to so correct the extrinsic muscles of the eyes to be sure of parallelism for distance and secure rest at this point, designated better, perhaps by the word equilibrium. He has invented many instruments by which deviations can be apprehended, both before and after treatment.

With this varied experience in tenotomy there has become a sanction for this operation for squint, and gradually it was authorized in other "imbalances" of the muscles. A relief of strain, possibly, in some cases of exophoria, which for a time looked promising, but subsequently made more trouble than before and brought discredit of it; so that now, this operation for divergence squint is not popular and never will be often performed.

The operation for convergent strabismus, under proper manipulation, holds advisable.

But the idea of "Muscular Asthenopia" has come to be well accepted, and more attention is given to the muscles. The general method of using loose prisms in Orthoptic treatment given over to an office assistant, or prisms taken home to use three to five times a day is very inefficient and haphazard. Practitioners under these circumstances do not recognize the muscular cases, but when asked if they treat muscles, say "yes, but it is a rare condition that needs treatment." Indeed, under these circumstances it may be said that Orthoptic treatment has not been tried.

In my book, *New Findings in Ophthalmology and Otology* (1911), I have given details and described cases. In my paper of 1920, published in the *Archives of Ophthalmology* and in others before mentioned, I have put this subject on a new basis, which occasions this publication.

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CHAPTER III

ASTHENOPIA A PATHOLOGICAL CONDITION; A SEPSIS OR DEBRIS IN THE TISSUES DEPURATION

At about the time of the meeting of the International Ophthalmic Congress in New York in 1876, there had grown a decided opinion that the extrinsic muscles of the eyes were implicated in the troubles designated asthenopia. This change of view from the doctrine of Donders that asthenopia was wholly caused by errors of refraction, and could only be relieved by lenses, was owing, I believe, to Dr. Noyes' able paper in that Congress and his subsequent writings.

In this paper of Dr. Noyes, entitled "*Analysis of 1079, recorded cases of Asthenopia and Muscular Weakness, with Deductions respecting Asthenopia*," he shows original thought and laborious investigation, as well as conservative care.

He says "The word Asthenopia has become current as a generalization to distinguish those cases in which use of the eyes is painful or difficult, and in which there is no ideopathic inflammation, nor any opacity of the medea." "Amblyopia may complicate it," and he proceeds to divide it into several classes, paying more attention to symptoms found, than authors generally have done when writing on this subject. I think he was the first who found that in some cases weakness of the muscles were alone the cause, and took in account in all cases of the power of duction. He made a distinctive separation

in accommodative asthenopia and muscular asthenopia. In his last work: *Diseases of the Eye* (1890), he has a chapter on Asthenopia, and gives treatment for these muscles on the basis of a pathological condition.

The recognition of the implication of the muscles grew very slowly, but the refractive method has become so popular that a new profession has been established, that probably outnumbers the oculists, and they have taken means of educating the public to their views, such as oculists do not practice and the fitting of glasses is very much exaggerated. Consequently, the people are attracted away from those who would find other methods of meeting their difficulties.

I cannot account for the slow adoption and development of the muscular treatment after such authority as Dr. Noyes found to be of such utility.

I was a pioneer in this business. I think I fitted the first compound glass west of the Mississippi River in 1869, and that I got out of this system all that was in it. With all my care in the pursuit of this science, I failed to relieve many, taking for a standard, *the free use of the eyes without pain or discomfort*. I at last sought the cause in the system of muscles, and was gratified beyond all of my expectations.

I found these cases very nervous, and could not endure the manipulation commonly used, before their eyes; when attempting to use frames on the nose or changing prisms in a box, as advocated by Dr. Noyes, the irritation from the motion necessary was very disagreeable; the sets of prisms were not adapted to discipline all of the muscles; indeed, that the use of loose prisms inefficient and unscientific. I therefore devised the Kratometer, as described in another chapter.

I came, also to the conclusion in this experience, that the fitting of glasses of low degree of ametropia, to a

young person, say under 30 years of age, when the vision was 20/xx and the defect was but 1.D or less of spherical, and a half degree of cylinder, when the axis of the cylinder was vertical or horizontal, was unnecessary, and sometimes a detriment. I doubt whether asthenopia was ever reached by it; that one having trouble with this condition of refraction, the trouble was in the moving apparatus of fixation. I have treated many such who have been fitted many times but got no relief, but were entirely relieved by treatment, and they often discarded their glasses. The Heterophoria, if present, was generally corrected, and they were restored to Ocular Orientation.

The pathology of asthenopia, seems to have loomed up in the mind of Donders, as indicated by his writings. "Writers," he says, "are accustomed to take refuge in a *peculiar pre-disposition* on what this so-called peculiar pre-disposition to asthenopia might depend. I soon became convinced that a moderate degree of hypermetropia was at the bottom of it (p. 260). When I asserted that asthenopia is the result of hypermetropia structure of the eye, I was thinking, not of a symptom, but of a portrait of disease (p. 262). There are still morbid states, whose symptoms have some resemblance to those of asthenopia. To these belong especially, insufficiency of the internal recti muscles, which von Grafe has studied. (p. 264.)

Our knowledge of asthenopia commenced with that of the phenomena of the affection * * * there was great difficulty in sketching a typical picture so long as the cause affliction—according to Taylor—in the retina Scarpa, in the nerves; Beer to weakness in the retina. (p. 270.)

Asthenopia, it seems to have been considered, a phenomena of some kind of force against the healthfulness

of the dynamic uses of the organ of vision. When there appears some evidence of a pathological condition, the physician seems to be out of line for investigation, and the question is thrown over the shoulder.

What has been done with intolerance of light under this administration? What for amblyopia, that creeps over the retina in asthenopic cases? What for slow fixation?

There is no greater satisfaction to those who undertake difficult problems, than to be able to generalize the minor puzzling practices and to get them allocated so they work harmoniously in getting results. The world knows of many such revolutions of thought in great subjects of general knowledge.

ASTHENOPIA DEBRIS

After spending twenty-five years or more in treating the muscles of the eyes for weakness, and finding satisfaction in good results, and retiring from active practice, in 1919 it occurred to me that this etiology of the problem, was the true one, and I reported my findings in papers published in the *Archives of Ophthalmology* of that year.

In all the discussions of the probable etiology of eye-strain, as asthenopia is familiarly called, the idea of a septic deposit as a cause of asthenopia, has not been advanced. That this organ with its muscular organism and so constantly at work, should sometimes be subject of unsanitarian laws, is a reasonable conjecture. The ophthalmoscope reveals a condition of the inner membranes that have not been interpreted. There is most always an increased redness and crookedness of the vessels and a cloudiness of the retina. There has been no direct cause of this explained and no means instituted to get rid of it. In deviations of the ball outward there

is a gradually progressive dimness of vision, well marked, and in many cases where there is no deviation, the light is dimmed in one eye more than the other. In these stages of degeneration, leaving out those of hemorrhage, toxin, uremia, diabetes, albuminuria, we have a gradually increasing amblyopia, which progresses to the condition of perception of light, only. Intolerance of light is often a symptom at first. Some authors describe hyperaesthesia of the retina, but after refracting, prescribe rest, and sometimes putting on colored glasses, but nothing further is done, unless it has gone so far that neuroretinitis is diagnosed.

In all that is done, there is no thought of testing the ability to perform that function of bin-ocular single vision, which should be the consummation of all efforts of improvement of the sense of sight.

I believe that in putting the muscles into action by the duction process I pumped the debris or sepsis into the circulation—Dupuration.

Let us examine this idea of deposit that obstructs, and at the same time try to decipher the impressions made on some of the workers in trying to understand the phenomena presented to them and were unconsciously having a glimpse of the real thing, but did not pick up the suggestion but worked close to it.

Dr. Dyer, in his report to the American Ophthalmological Society, before mentioned, in cases of asthenopia, not connected with hypermetropia said he recognized on examination of the retina, the optic nerve was not clear, and the choroid was striated. In his paper to the International Congress on the same subject, he insists upon systematic exercise of the muscles of the eyes not only in cases of asthenopia, where no error of refraction existed, but also where the asthenopia was still persistent after the ametropia had been properly corrected. He

said: "It is necessary for the average patients to give up all other employments and devote three or four months to the rigid course of exercise and treatment.

This discipline of Dr. Dyer's was the exercise of the converging and the ciliary muscles, and was done without any set principle. He was, however, pumping asthenopia out of the tissues with very short action, and employing but a part of the machine.

Dr. Noyes in his paper at the International Congress, attempted to isolate the various kinds of asthenopia by symptoms. In the seventh class he mentions intolerance of light. In the eleventh class, on examination of the interior of the eye, he finds "as a matter of course that the optic nerve is hyperemic * * * existing in the capillaries, veins, and in some cases in which the arteries and veins were both distended and senous; twisting about in a remarkable way, not to be diagnosed neuritis or retinitis." See Transactions of the Fifth International Ophthalmic Congress, pp. 158-9.

I do not find in any other author, writing before the date of this paper, hyperaesthesia in the catagory of asthenopia. He says further on, "I am not sure but that we will yet discover some hitherto unknown case of this exalted irritability in a constitutional dyscrasia, or some abuse of the eyes."

Dr. D. B. St. John Roosa would not believe that there was muscular asthenopia, but at the International Congress, mentioned above, he presented a paper: "The Relations of Blepharitis Ciliaris to Ametropia." He believed that errors of refraction were the cause (not the sole cause) of this distressing malady. This etiology has been generally accepted. These abscesses of the Myobom glands, point directly to a discrasia.

Many observers have remarked that asthenopia is a

sequence of scarlet fever, typhoid fever, dyptheria and malaria.

I am now convinced that the cases of chronic conjunctivitis, trachoma, iritis, cyclitis, etc., which I treated in great numbers, had more or less at the beginning—asthenopia as a remote cause.

Many of these asthenopic cases that came to me in later years, exhibited redness of eyes with some intolerance of light, dullness of expression, the conjunctiva either watery or dry and hot, dull, sunken and soggy. I have, instead of, as of yore, put them under treatment of the muscles by the Kratometer and without any collyria, or any other application. The conjunctiva and other congestion would clear up in three or four days. The eye would put on that white glistening appearance of a healthy eye. The other coats would give evidence of clearing up.

Dr. Noyes recognized this symptom in asthenopia and endeavored to make the distinction between asthenopia and inflammations.

Every oculist has noted that inflammation of the eyes, one layer, alone may be the seat of the disease, and the other layers be quite free from implication. The anatomy of the vascular system will explain why this is so. I have observed this independence of abnormality in asthenopic troubles where it cannot be said that it is inflammatory. In these cases the lids are not found stuck together in the morning, which symptom is an evidence of inflammation; but for months, and may be years, they get up with this redness and a white streak of deposit on the edge of the lids. In other cases the inner coats are congested; the uveal tract may alone be excited. The retina in asthenopia has the appearance of a deposit like smoky chamber, a dull gray, and vessels tortious.

INTOLERANCE OF LIGHT

Intolerance of light is so closely associated with retinal hyperaesthesia, and other asthenopic troubles that a differentiation is not necessary, for they all get relief by the treatment of the muscles of orientation.

Years ago I saw cases of such photophobia that the patient could not go out into the light of day without a close-fitting visor that kept the eyes in darkness. The examination of these was made in a dark room with a single candle, the light reflected into the eye by the ophthalmoscope. There was nothing abnormal but a very red retina with vessels seneous. At that time I did not associate the symptoms with muscular weakness or asthenopia, and to this day I have never seen any direct treatment until I found results in correcting muscular weakness by the Kratometer. There are an immense number of people who wear tinted glasses or black glasses for intolerance, and nothing done for them but putting on lenses.

This condition is very often associated with strabismus divergences, and many who have intolerance of light at the beginning, but after the period when they cease fusion the intolerance is gone, but the vision of the off eye, deteriorates, and often is so diminished that perception of light, only remains. I have seen many blind people whose eyes have taken this course, one eye following the other in its history. This, I class as asthenopia.

That asthenopia and eyestrain are the most prevalent diseases of the human race, is not at all an extravagant belief, in my opinion, and there are at this day as many of pure ophthalmic cases that are amenable to treatment, and do not get it, as there are of those that are cured. There is a wonderful field for the best there is in us to find the relief. This is my belief with some theory, but

it is deduced from experience. One is entitled to speak his theory after working with facts to get it!

This asthenopia which we are trying to educe is the enemy of this "end organ" which is used more than any other of the human system. When we realize its supreme office (see chapter IX) and our dependence upon it for safety, livelihood, amusement and happiness, we are amazed that it bears up under the requirements in so high a percentage of people.

Nevertheless there are many that are defective of sight. We know the prevalence of wearing spectacles. This branch of optical service for which glasses correct, is but a small portion of eye defects, and the other half of the number of deficient eyes are not yet recognized, or at least not sufficiently understood to apply remedies for their cure.

Modern requirements of this organ of vision are being multiplied; the movies method of amusement is one example, lately coming into vogue. In specializing of employment in business and factories, the eyes receive more burden, and are called upon increasingly to meet the requirements. The science of ophthalmology has not been able to meet the complications that are developed under the new demands.

Let one learn to detect, and when in public gatherings notice the many who have a "cast" of the balls; and observe the number of people who are distressed in reading or in riding in autos or trains. But beyond the estimation of those outside that have defects that can be identified, there is a large percentage of people who are deficient in ocular orientation that do not show it (see Chapter IX). It may be from childhood or school days, who have been hampered in getting an education, or have been unable to participate in games or competing with their associates.

I will here relate the history of a case which I had the opportunity to study for a long period, and I think will illustrate the insidiousness of the condition which I am trying to bring to the front.

In 1871 a young lady of German parentage, a school teacher, consulted me for Blepharitis marginalis, in which the cilia were nearly all destroyed from repeated abscesses, occurring throughout her school days. There was no manifest hypermetropia and no astigmatism. She had worn glasses for two years, but discarded them. Her vision was 20/xx and she did not complain of difficulties of vision or pain in the severe studies she had occasionally to prosecute. In a few weeks she was entirely relieved of the lid trouble, and there was no occasion apparent for assistance by spectacles.

I have, since the above date, had opportunity to follow the subsequent history. She married, and raised a large family. She has been able to use her eyes at close work and reading, and presbyopia developed early and 2.D of hypermetropia, which being properly attended to, there was no apparent trouble in using her eyes.

But for these many years, she has had insomnia, sleeping on an average of three hours every night, with no sleep during the day.

This was unknown, even to her husband, and the only apparent evil consequences was diabetes, coming on about the age of sixty years, which may or may not be attributed to asthenopia.

Dr. Ranney describes many cases of insomnia but they are accompanied with painful symptoms about the eyes, and an "imbalance" or a "latent imbalance," usually an exophoria. This case of mine had esophoria, but no acute symptoms. In later years I have given both adduction and abduction, but the duction standard was attained

with unusual difficulty, and the hope of curing the diabetes has not yet been realized.

This case, even if the conjectures regarding it are correct or not, in the light of the theories I have suggested, that asthenopia is something of a diatheses in the organ of vision, is an interesting one in the possibility of its being an example of its probable rareness and wanting in many acute symptoms of insomnia which may in other cases be more pronounced.

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CHAPTER IV

REFLEX SYMPTOMS SYNDROMES

It is very evident to me that the symptoms connected with "asthenopia" have been very reluctantly listened to by Ophthalmologists. In some of our textbooks we find it advised to "make rather light of their troubles," that these cases "have too vivid an imagination and are fretful under these debilities."

Many of these asthenopes have applied to a number of practitioners, and some of these with the "I am" argument have declared that they need go no further, for all has been done that can be done, and a moral lecture ensues on the subject of self control. I imagine after all of this, there is very little sympathy at home.

In the attempts to come to conclusions of diagnosis, there is a great difference of opinion regarding the symptomology, etiology, and diagnosis, and so when only half of the cases are made whole by the treatment in vogue, the mystery grows.

Dr. Noyes paid more attention to the symptoms in relation to eyestrain than any other author of my acquaintance. He classified these symptoms into thirteen "species," but he does not use this classification as an aid to the etiology of asthenopia, but says: "I wish to declare my strong conviction that for the immense majority of cases of asthenopia, an adequate and intelligible cause can be found—one will not defy examination under the vagueness of general terms."—Transactions of the Fifth International Congress.

Dr. A. L. Ranney of New York, Professor of Nervous Diseases, and an Author of *Lectures on Nervous Diseases* and other works, among which is one on *Eyestrain in Health and Disease* (1897).

He was an anomaly in the profession, linking the profession of Ophthalmology and Nervous Diseases. Although I never followed in the manner of remedy, I think his experience is of value in the matter of diagnosis. He classified his 100 cases on the basis of symptoms displayed: "Headache and Neurology," "Chorea," "Sleeplessness," "Chronic Gastritis Digestive Disturbances," "Epileptics," "Nervous Prostration" and "Insanity."

He used the word "Reflex" as a word for the transfer of the manifest acute symptoms to other parts of the physical corporeal body, but makes no attempt to explain why one set of nervous symptoms are put in deleterious action and others left undisturbed.

Oliver says: "It is in heterophoria type of asthenopia, particularly the Hyperopic varieties of minor degree, more than it is ametropic one, which gives rise to so many reflex neuroses. It is in this type of disorders that dizziness, gastric disturbances with urticaria, for example—vertigo, migraine, nervous irritability, mental confusion, insomnia, etc., all of which are so prone to interfere with general nutrition come into existence * * * some of the more permanent morbid processes of the central cortex itself known under the name of chorea, epilepsy, etc., may in a measure be indirectly dependent on disturbed bin-ocular action."—Olivar System of Eye Diseases, Vol. 8, p. 406.

It is my purpose to show that this intricate mechanism of the bin-ocular apparatus is subject to many disorders and that very many of the familiar diseases or neurotic symptoms that are such a mystery to those who are subject to them, and to those physicians who undertake to

cure them, are seated in this apparatus which is presided over by orientation; that the understanding of these muscles and the proper orthoptic treatment of them will restore fifty per cent or more of them and cure completely those cases that are designated eyestrain, asthenopia and a score of symptoms that rise up like Banco's ghost and will not down, under the present regime.

This phenomena of asthenopia has been the study of years in the handling of these cases, and it has been a great quandary when a patient presents himself with symptoms with well marked exhibition of a nervous disease under the nomenclature of another specialty, and which succumbs to the treatment of another specialty, quite foreign to that which the books denominate. The mystery thus witnessed, I believe has been the cause of the unwillingness of the physicians to express their minds on the situation.

I have had three cases of chorea, two in which I got perfect relief by muscular treatment; several of neurosthenia, migraine and some with mental disturbance. In declaring that my treatment cured the well marked disease I was met with the declaration that "if you cured them thus, it is evidence your diagnosis was incorrect."

These symptoms which we find in asthenopia and denominate syndromes and which heretofore have been treated with drugs and severe hygienic measures and given names that when pronounced give a shiver, are in later years being given a different complexion. Neuraesthesia from being considered a nerve disease requiring prolonged rest, to the belief that it is not organic, but "only nervous:" in that instead of neuraesthesia producing eyestrain, eyestrain has produced neuraesthesia, and that restoring the eye to its normal function, the neuraesthesia vanishes. Some such transformation in other forms of nervous diseases are found if we accept the

report of Dr. Ranney. (Eyestrain in Health and Disease, and the writings of Dr. George M. Gould.)

The common use of the word "Reflex" wherein we test for "knee jerk" in which it is said it is "an exchange of function of the 'afferent and the efferent nerves'" is not applicable in understanding the phenomena of so many nervous symptoms connected with the eye disorders.

It is something we do not understand how the disorders of eye functioning are exhibited in the many symptoms of nervous disorders whose nomenclature and treatment have so long received the attention of specialists. It is one of the deep physiological combinations of life in the human system. The study of it will not furnish us an elucidation of our subject of eyestrain. The question at present is, Is it a fact that these bouquets of nervous symptoms are found in connection with eyestrain and that they are driven away by the treatment of the eyes?

Electricity is now a common article of use in power and light, but we have not yet found what it is!

There is another use of the word reflex. It is common to express the fact that the irritation of one organ is reflected to another, more or less remote, to the nose, or stomach or uterus. In the special use of the word which we are trying to elucidate, which use is not so common in the professional writings, reflex is the exhibition of nervous symptoms in disorders of the eye, is an irritation produced on the contiguous nerves, which, like those of the eye nerves, branch out from the cerebral cortex. The reason why the disorders of the eye do not produce uniformity in all cases, is that the person having the disorders, has the power of resistance to certain syndromes, constitutionally (not under the will), but not

others. Some may have asthenopia for years but not exhibit it by disturbance in any of the syndromes.

We know it to be a fact in general diseases, that some people are immune to some diseases and very susceptible to others. This power of resistance of the system, shows itself in many ways.

In further consideration of this phenomena of reflex, I would note the transition of views in the profession regarding the syndromes of a number of so-called diseases, and which are now principally found in these reflexes that are relieved by eye treatment.

The change of attitude in this department is one of the most remarkable in the history of medicine. The experience I have had in treating in this particular field has made me quite familiar with this condition.

About the time that Drs. Noyes, Stevens and Ranney (1879-1890) were at work in this field, there had been "brought the rest cure" advocated by Dr. Wier Mitchell, for case of nervous collapse, which was said to have "happy results." It consisted, says Dr. Ranney, "of voluntary isolation for months at a time, in bed under charge of nurse, without reading, writing, playing games; not to use their eyes at all, which was essentially a *rest treatment to vision*, as well as to muscles. It practically reduces to minimum in these patients all leakage of nerve-force from eye-strain. It allows of a fresh accumulation of nerve energy * * *"—(Eye-strain in Health and Disease, p. 271.)

Dr. Ranney's discovery was in finding the cause to be in the muscles. My experience has found that the real asthenopia (not eye strain) is in anomalies of the muscles and that it is not necessary that there should be heterophoria, or latent heterophoria to cure it by treatment of the muscles, but to know that the muscular system is out of order, and unable to perform its function. There were

numbers emmetropes, orthophoria cases which were relieved by muscular exercise, and unless there was intolerance of light or marked degree of heterophoria, a few treatments relieved them of pain and restored them, and the syndromes flew away like a covey. Often I had difficulty in keeping the patient under treatment to bring them to standard duction to assure them of complete cure. Not one in twenty relapsed under two years. The majority had no more trouble as far as I could learn.

This is the mystery! in the relation to these syndromes to Ocular Orientation. Is it a warning of the danger in brain culture? Is man, by over culture of the brain to go the way of over-development of the beast?

CHAPTER V

THE STATUS OF THE PROFESSION REGARDING EYESTRAIN OF "ASTHENOPIA" AT THE BEGINNING OF THE TWENTIETH CENTURY.

There is no better way to understand a new view taken in a proposition in the world's work than to have first, an understanding of the views held by those which are controverted. With this assertion it is necessary to examine the status of the profession regarding the subject of the difficulties of the eyes in performing the function of vision.

The nearly half century of the history of the period in which we have paid particular attention to this, has been dominated by the great system of Donders' "*Accommodation and Refraction*," and the faith in his doctrine and the utility of his remedy, has filled the world with almost universal admiration.

In regard to the doctrine of "Muscular Asthenopia", not only was the idea of "imbalance" made a foundation for an operation as a remedy, but when asthenopia was found present and no imbalance, it was believed that imbalance was "*latent*" and by wearing a prism a few days that indulged the muscle, it was made apparent that the cause was imbalance and therefore a "graduated tenotomy" was indicated.

This propaganda has been followed by a few. The correction of strabismus, both convergent and divergent, is however sanctioned to this day.

Aside from the subject of squint we find in the exam-

ination of authors on asthenopia, a difference of attitude and practice; one seemingly mechanical in its nature, and the other pathological. While recognizing that there is an accommodative asthenopia and a muscular asthenopia. Landolt, Stevens, Savage, de Schweinitz, Fuchs, Howe, Ranney may be regarded Eye Engineers that correct what they find in a mechanical way. They are exponents of tenotomy. They hold to the doctrine that imbalance is "the condition in which the accommodation, convergence and torsion do not bear their normal relation to each other"—that eyestrain is that of contending forces—a spastic condition, between accommodation and balance; a wrestling of these two struggling contentions, and the business of the oculist is to break their hold; the weakness of some of these muscles is attributed to the superior strength of the opposing and recalcitrant muscles, which are caused by misfits (muscles too short or too long). The many symptoms that are found and not relieved by glasses and scissors are considered to be produced by constitutional disorders.

The ophthalmologists do not grasp the full significance involved in a thorough understanding of the true function of vision, is a fact that stares us in the face.

The ocular motor apparatus has the office of adjusting and controlling the function of Orientation. These muscles are the last apparatus of our scientific management and control of the visual apparatus.

We emmetropized the refractive apparatus with beautiful spectacles. We have balanced the heterophoria by weakening the stronger muscle with hook and scissors.

But the understanding of the superior purpose of this function of orientation in accomplishing its severe task, we know little about.

What of the hitching of a train if there is no journey?
What is there in music if not controlled by time?

What is motoring without a functioning engine?

What is a body without a soul?

There is a coterie of men who may be considered as the conservative group, who hold the doctrine of Donders and who invariably try glasses and if not successful in relieving the first time, review, and continue to do so as long as the patient will put up with it, adding at times constitutional treatment and calling in other specialists or general practitioners.

The discussions of medical societies on this subject generally end in describing minutia of examinations by some, and a declaration that there is not enough attention paid to constitutional causes, by others.

The doctrine insistently preached that errors of refraction are the cause of asthenopia has led to very exacting, hard and fast theories and arguments are used that are unwarranted, forgetting that nature in physical building, is very elastic, and deviations in structure about a central principle are very common in every living thing.

There is no better example than the fact I have found, that when the muscles are in order the eyes will perform their function with ease when considerable ametropia is present.

"Orthophoria like emmetropia, is a theoretic, mathematic and geometric standard, and is no more expressive of normality of tissue and harmony of action than the latter. Normality can be assumed, no matter what inequality may exist, as long as the two series of ocular muscle groupings are in balance and continue so during activity." (Oliver system, Vol. IV, p. 405.)

Another example in this connection, with regard to cause and effect of syndromes, the doctrines of which are held so tenaciously because of some authority.

The emphasis on the necessity of finding errors of refraction is most profound and almost universal. I have

frequently had patients who had consulted fifteen or more, and I have had the opportunity of seeing the changes made in some cases. These were generally cases of very slight errors, and there was very little difference in the formula and yet the patient would hope that some one would find the error and set them free.

Schools have been advocated where a two-year's course of post-graduate work, to learn this art of correction of refraction. "All that is yet needed is the education of two thousand skilled refractionists." (Gould's Biographical Clinics, Vol. VI, p. 27.)

Dr. Gould has found 78 reasons why others had not found the proper correction of refraction. (See J. A. M. A., Oct. 28, '05.)

He says "absolute emmetropia—mathematically perfect pair of eyes do not, I believe, exist. (Biographical Clinics, Vol. III, p. 500.)

I have known persons who were wearing, over one eye $1/8$ D. and over the other a plain glass.

There has been a decided division in the profession regarding "Accomodative" and "Muscular asthenopia." We have not been able to differentiate, before treatment, between the two without trying the means applied to refraction and the application of prisms to the muscular system.

I ascribe the little attention to the muscles as one reason, the want of proper manipulation of prisms. The handling of the prisms require handiness much better than in lenses, and the quick disposal of the service is not so easily completed.

But experience soon gave rise to doubts of its infallibility as early as shown by Dr. Dyer's paper in 1865, and in the course of twenty years the profession was well divided on the subject of eyestrain. On the one hand those who had placed confidence in the systems of Don-

ders, and on the other that though the correction of ametropia in a high percentage, there were many not relieved by it, and it was found in the muscles that regulated the globe in fixation, were implicated in the problem. About in the '70s the muscle theory had many advocates. Dr. H. D. Noyes was foremost in promulgating the theory.

The three men of New York City, Drs. H. D. Noyes, Geo. L. Stevens and A. L. Ranney, were definitely engaged in the problem of muscle anomalies as a cause of asthenopia in the decades of '70, '80, and '90. In classification, pathology and remedy they differed very much. Dr. Noyes represented the nearest to the pathological idea, and depended more upon exercise of the muscles as a therapeutic measure. Dr. Stevens' mind towards it was emphatically mechanical, both as to condition and remedy. He tenotomized. Dr. Ranney classified pathologically and tenotomized.

These three men were indefatigable writers, and evidently believed in their views. Their experience thoroughly demonstrates that the muscles were at fault in asthenopia, but for some reason best known by those who tried tenotomy, this surgical treatment was not followed extensively.

To obtain a "balance" the stronger muscle was made weak. This does not seem to be logically correct or good practice.

The tenotomy of the muscles in Strabismus convergence and the "advancement" of the muscle in "Strabismus divergence" is still sanctioned, but these involve the muscles of convergence, and the operations were established before heterophoria and imbalance was conceived, but nevertheless will eventually be abandoned in both, for the more logical orthoptic treatment; divergence has already succumbed to the new principle.

The decadence of tenotomy in deviations of the eyeball

is a remarkable fact after Dr. Ranney's publications of such success in his graduated tenotomy. But his knowledge of the nervous system and symptoms connected with the muscle anomalies should be utilized. The study of his groupings of nervous systems clears up much of the mystery connected therewith.

Dr. Ranney used prisms in spectacles, temporarily, but how much he used duction as a curative measure is difficult to tell.

DUCTION BY LOOSE PRISMS

There are a few who attempt the use of prisms. They use the large square prisms manufactured in sets. Generally in the hand. Taking for instance, 5° , 10° , 15° , 20° . These combined will amount to 50° . The intervals at best are only adapted to adduction. Duction of other pairs have not been attempted so far as I know. A light is placed at one end of a moderately lighted room. The patient at twenty feet from the light, puts before one eye the 5° prism with base out. If the two points of light produced by this prism come together fused, they put the 10° over the other eye, while the 5° is still over the other eye; if the light is fused, proceed by laying down the 5° and put up the 15° , and so continue until all of the lenses are before the eyes and fused. The standard adduction of these internal recti is attained. But there are very few persons who can do this with prisms of 5° . They can be trained by batteries of less interval, and when accomplished this way, can perform the act as above. The practice of using prisms in this way is very laborious, and when done at the office is generally turned over to an office assistant. It is not easy to take up lenses and hold them in proper axis, and not touch the eyelashes, then putting the first down or adding another to it. So the set is given to the patient or one or two at a time, and after a month others given.

Motion before these patients' eyes is very aggravating and this manipulation will drive them away with discouragement. This exercise with some I have known, has been carried on from three to five months, three times a day.

THE ROTARY PRISM

There are some optical instruments equipped with Risley's rotary prism to use for the same purpose. This device is a combination of two strong prisms put together in a case, base of one against the apex of the other, plane to plane. When the thumb-screw is applied to the machinery, one prism revolves one way, and the other prism the other way, making the effect of a generally increased prism, in amount according to the strength of the prisms used.

The effect of this rotary prism is a gradual increasing prism from zero to the combined effect of two prisms, with a gradual pull, which does not imitate the act in nature, and is of the nature of strain on the muscles—a drawing sensation, whereas in the battery principle the object (a light) is thrown on the periphery of the retina at every change of the prism, suddenly, which stimulates the fusion sense, and causes an impulse to fuse, which is the secret of its effectiveness in obtaining good working of the muscles, and the muscles being built for speed rather than strength, are adapted for jumping the space, and then there is rest, rather than the appeal given by the rotary to strength and continuation.

The axes of the prisms in the battery are in line with the pull of the muscle, especially at the end of the lift, when it is needed the most, which I doubt is the case in the rotary.

I have used this prism in ascertaining the -phoria of the patient, but I regard it not good in getting the duction of the muscles. I have believed that the thrusting in of a prism, that throws the image of the light, suddenly to

the periphery of the retina in this exercise is much superior than the gradual movement towards the periphery, and is imitating the process in ocular orientation.

During the long period of particular attention to the visual function, there has grown a professional exclusiveness with the eye men, and a division in their own ranks. The ophthalmologists are the personification of orthodox autocracy so far as opinion is concerned. This shows itself in the matter of the treatment of these disorders, as well as the ethical questions, and the custom of keeping their literature from, even, the rest of the profession. Since the decadency of operation on the muscles for heterophoria, oculists have fallen back into the belief that the only hope in asthenopia is in the finding of the supposed obscure error of refraction, or getting the scent of the constitutional causes.

I may be allowed to refer to the last symposium on the visual function in the section of ophthalmology in the American Medical Association in 1919, as an index of the full setting of the opinions and methods regarding the subject.

The fine portrayal of unrecognized symptoms, and the facts told the section by Dr. Emerson at that meeting, and also the suggestions made by the chairman, to take some means of education of the people, did not result in as much as an echo in the staid and secluded body.

The transactions of the section are published and sent to the members of the section, and are not even published in the journal of the association. The papers of oculists cannot be published in the journal but are sent in book form to the members of the section. Other papers written outside of the section are sent to the special Ophthalmic Journal.

The general profession do not get the benefit of the knowledge of the oculist, saying nothing of the public.

While the wise tortoises are discussing the past and building a shell of dignity the hare is eating up the forage!

CHAPTER VI

THE AUTHOR'S METHOD OF MUSCULAR EXERCISE: THE KRATOMETER EXPERIENCE

Amid the extraordinary following of Donders' system of *Accommodation and Refraction* to relieve the very common distress of asthenopia, there were but a few oculists in the first decade who suspicioned the motor system of the eye was much at fault, and there arose a distinction between the two, one being considered mechanical in its method of relief, and the second as a physiological answer to the problem.

Instead of accepting the assertion, vehemently promulgated, that because relief did not come from the first fitting, it was because of the want of skill in the search for hidden ametropia, I turned to the study of the muscles in the early '90s.

Starting as I did from the correction that these motor muscles could not perform their work because of weakness, either in the muscular fibre or in the innervation, it mattered little, I arranged the means to give them muscular discipline, or discipline by prisms, with gradually increasing strength in batteries. The training of the muscles of the eyes was a new field, and there were no instructions to be had, so the adventures in the processes were numerous and mistakes were inevitable.

I constructed an instrument in connection with these batteries which I named Kratometer on principles I regarded necessary to call these muscles into action, believing from general principles, it was not rest they needed,

as was then strongly advocated to cure muscle difficulties, but work under proper restrictions and care. I recognized the difference in character of these muscles, in that some had a much greater excursion than others and therefore a difference in their elasticity.

To be more explicit, there were 50 units from parallelism on the convergent act, and sometimes 30 or 40 on the other side from parallelism. The interval between the prisms in this battery was one degree. The external recti, to get the standard, there were 16 units of a half degree. With the verticals there were 12 units to get a quarter of a degree.

To present these batteries before the eyes to the "fusion sense" to induce action of the muscles, they were run in a groove with the axis of the prisms with the pull of the muscles and on a plane with the face of the patient, (who looked through eye-cups with a half-inch aperture), gradually increasing strength and acting smoothly until reaching the point of inability of the eyes to fuse the object (which is a light). Then the battery is withdrawn and the patient is allowed to rest a few seconds. The appealing to the muscles by small intervals, with regular rhythm is especially efficacious particularly toward the end of the lift, to break up the inertia from long idleness.

By these prisms, I have been able to discipline one set of muscles as effectively as another; that is, I could get a unit with the adapted prisms on the verticals and correct the heterophoria in either.

The principles I found necessary, further, in handling these muscles were: First, the maintenance of a vertical, horizontal and oblique axis, mathematically, so that when the axis was found in the muscles that needed discipline, the prisms would excite movement if my manipulation was quietly and smoothly made, without variation of

axis. Second: The grooves in which the battery moved must be in line and correctly centered, with axis of prism also exact. Third: The prism batteries were adapted to the pairs of muscles, with the intervals uniform in degree; for the laterals 1° ; for the verticals $\frac{1}{4}^\circ$.

With the suggestions and queries that Von Grafe made, and systematic and careful, and I may say courageous way Dr. Noyes presented his findings in asthenopia troubles, it is singular that the muscular treatment of the eyes has not progressed more than it has. I believe, aside from the profitableness of glass fitting, it is owing to the special requirements of the muscles to be exercised; the delicacy of touch, patience of investigation, and the correct interpretation of the phenomena observed.

These muscles are not like other muscles of the body; they are "built for *speed*, more than for strength-fibres end to end."—*Maddox Ocular Muscles*, page 114. They are easy to break down with too much exercise and poor manipulation. What is done in the line is generally turned over to office assistants.

From the long experience in exercising the muscles, observing that the congestion would disappear, and in some cases like magic, leaving no after effects; that the glasses that had been worn assiduously, perhaps for years, were now found to be unnecessary for comfortable vision, unless the degree of ametropia was great; that new ambitions in life, and better health were so soon enjoyed thereafter, I could not explain the change only by my theory of debris, to which I have later ascribed it; this was the obstruction, weakening them and interfering with the action of the function of orientation, and I got rid of it by this exercise.

This conclusion with regard to asthenopia and the better conception of the office of this beautiful apparatus came to me in these later years like a vision. Vision?

Yes, vision! I have yet to explain this grandest organism of Nature's environment in these pages. See Chapter IX.

The value of prisms as a therapeutic measure in ophthalmology does not seem to be comprehended by those who administer to the function of sight, certainly there must be some who have suspicioned that deviations found in this apparatus must be from disability but if they have been awakened, they found no instructions how to proceed to correct, except by tenotomy.

I believe, too, there is a general prejudice against the instituting work for a lame or weak muscle.

The goal to be reached in all repairs of disabilities, is the perfection of the function of orientation; to make plain the object of projection, and the easy and quick faculty of the fusion act.

This is the acme of all of our endeavors. We have come far short of our duty when we merely sharpen the vision, correct the imbalance, or even when we have stopped the pain. To enthrone this wonderful sense with spectacles is not much; there is a function to perform which needs far greater service!

The relevations of Drs. Noyes and Ranney have not been impressed on the workers of this generation as they should be. The use of prisms in spectacles is an abuse, and the use of prisms loose in the hand is a long-drawn out apology. The cases that have been benefited in that way could have been reached in one-fifth of the time.

Dr. Noyes did not reach the item of smoothness of manipulation required and the small intervals at the extremity of the lift that I found necessary to make progress.

Prisms are the only means we have of artificially producing the effect of moving objects in the natural act in the field of vision when we are in the open. The images

of the objects in either case, are projected upon the retina aside of the fovea in one eye, and the impulse is to fuze the inaccordant objects. Fuchs says: "For perception of movement as well as slight differences of luminosity the periphery of the retina is actually more sensitive than the center. Aeripheral vision is therefore a service in orientation. The images upon the periphery give us warning signals which make us cast our eyes directly on the objects which excite, and it is moving objects that are most sure to attract our attention."

I have always disciplined on the far point, 20 feet or more. The point of rest in waking hours is at this point in a pair of normal eyes and there should be equilibrium for distance as an economic proposition. If the muscles were brought to the physical standard of strength already set: adduction 50° , abduction 8° , infraduction 3° and these acts were performed quickly without pain, I found accommodation and convergence normal as a rule and the function of orientation was performed perfectly. This is to say that the eyes would be in equilibrium, but if not, it was of no consequence, for there is able excursion of the balls, and nature would soon bring to the starting point. So far as I am able to examine those who had a heterophoria at the end of the treatment, this was generally the case.

I have had but little experience with the use of the stereo-scope, and none with the amblyscope. Its applicability to train muscles to perform the function orientation, I never could appreciate. To me the first is a trick-box. There are several constructions under this name containing reflector and refractors which produce "relief" in a duplicate picture with a flat surface. This performance is foreign to the natural condition, although it interprets perspective, which is in the act of orientation, but

it does not do it in the same way, or call upon the muscles in the same manner as in the natural act.

The use of the amblyscope of Worth is of greater mystery; two pictures are here presented, one unlike the other, and the patient is asked to unite the two: a cake for one and a bird for another; a man without a hat, and the other a hat; a man with but one leg and the other a picture of the missing leg; a clock, another with the hands. The patient is asked to unite these companion pictures. *That is not "fusion!"* If that trick can be accomplished of drawing these unlike pictures together, it is done by the unusual will power thrown onto the eye muscles, the act is not fusion! It is like the ability that some have of squinting for a short time, as in a performance on the stage.

If a person should practice this amblyscope trick, he might be puzzled on his walk in the open, to see a cow in a pasture dart into a near house; a woman dart into an automobile; a man into a saloon!

The exophoric and exotropic condition of thousands are from eye muscular weakness. It is astonishing to witness the number of people seen in public places with this deformity, and who have given up obtaining relief, and there are other thousands who are in the first stages, who are not so easily recognized, and who avoid going into crowds, because of the pain that it produces to fuse. They cannot endure motion and avoid travel; car-sickness, sea-sickness, panoramas or movies are the bane of their existence. They may be at times induced to attend the theater, a social function, or take a joy ride, and may feel comfortable at the time, but it is the nature of reflex symptom that the irritation is not felt until several hours after, nevertheless it has its penalty surely in the near future.

Other "imbalances" are hyperphoria and cyclophoria.

These are not so common, and generally not so painful, although they are the cause of a nervous type that produces a sad countenance. It is often mentioned that two images of objects are seen, one higher than the other, but they do not complain of pain.

It is only occasionally that these deformities are seen in photographs. The photographer knows well how to hide it by turning the face towards the recalcitrant eye, and they "touch up the negative." The Czar of Russia had exophoria, and the Kaiser has it. These deformities and those on the road towards them, are sometimes given prisms in spectacles. But this is but indulging the weak muscles, and the strength of the prism has to be increased and actually this means of prescribing only helps on the wayward course.

The pathological condition of these muscles is seen when they are attacked by prisms; they are stiff and show want of flexibility, or elasticity in performing the movements we expect of them. Dr. Noyes discovered this and found that when the patient attempted to describe with their eyes, a large circle, projected a few feet distant, the eyes would hitch and show lack of smoothness of execution.

In whatever condition these muscles may be, whether the fault is in the fibre of the muscle, whether it be from obstruction, or whether it is in the innervation, it makes no difference. The fault is they are unable to fulfill their office. The point to look to, is what pair or pairs are at fault. We direct the treatment to that pair and restore them to the ability to overcome the prism or combination of prisms that the standard calls for in that pair. Added to that ability to correct this amount of prism degree, and the speed with which it must be done.

Each pair of muscles must have their attention to fulfill their participation in the act of orientation; indeed all of

the muscles participate to some extent in a perfect orientation.

"Imbalance" or deviation of the axis of the balls from parallelism, upon which so much controversy and theory have been spent, and which have involved so many operations, is but an evidence of a want of harmony in strength or ability of one muscle between its antagonist. It cuts no figure in the treatment from other weaknesses, but the -phoria when examined from time to time, shows the effect of the treatment in equality, in that pair, and as a general rule the heterophoria is corrected. The corrected "imbalances" are brought about by restoration of the tone of the muscle, and is likely to maintain its parallelism. When by treatment, the moving apparatus is clear of all obstacles for assuming this resting point, and there is still an imbalance, Nature will soon bring the axis to parallelism. The divergence that may exist can be temporarily overcome, because there has been made by the treatment easy movement. The essential elements I find in using prisms are: moving them continuously on the same axis, and the prism axis in line of the pull of the muscle being treated, especially about the end of the lift; smoothly without jar, with the increase rhythmically; after each lift a short rest, and lastly, not to overdo, for it is easy to do this and make conditions worse.

The Kratometer is built with a view to easy manipulation, and on right axis and properly centered. It meets the condition of dread of motion in patients, by steadying the face at the right distance from the movement. When manipulated correctly the treatment does not add to the nervousness, and there is a pleasure in returning for more. In each treatment there are passed from 100 to 200 prisms at a sitting.

I always treat on the far point. I never discipline on

the near point. Accommodation is increased and generally convergence is found normal when the standard is reached for duccion for a distance.

HYPERAESTHESIA OF THE RETINA

This is another grouping of cases belonging to Muscular Asthenopia for which there is nothing being done except prescribing glasses of different tints, ranging up to black glasses. Normally the eye is suited to the light and the light to the eye. Photophobia of different degrees of intensity is very common. It accompanies many other symptoms or may be an anomaly alone, the conditions of the outer coats quite normal in appearance, but with the ophthalmoscope, a deeper red than normal is found, with the vessels tortuous. I have seen cases of this condition that could not bear a ray of day light, wearing a visor that fitted close to the face. To examine these cases I took them into a perfectly dark room, and with a single candle reflected the light of it, into the eye with the ophthalmoscope, examined them. These cases were a great puzzle, until I could attribute the condition to disorders of the muscles. This cause was arrived at by treating the muscles at a venture and curing them.

This intolerance of light accompanies many forms of muscular anomalies. The distortion of the face in intolerance of light, in which they squeeze the eyelids to make a narrow slit between them, is very prevalent.

Then again we have the long face with the drooping eyelids, the pale, nervous face.

Taking these few groups, they make up a high percentage of every community, and there is no adequate treatment given them. They are, however, amenable to treatment through the recognition of being the victims of muscular asthenopia.

Ophthalmic literature contains accounts of cases of

acute symptoms in muscular asthenopia, wherein there was good vision in both eyes and the baffled oculist knew nothing to do, but suggested the removing of one eye, at last the patient asked and begged to have this radical means performed. It has actually been done in several known cases, and I mistrust that it is done oftener than we suppose. But what a tragedy!

I do not hesitate to say that the most of these latter cases can be relieved by judicious treatment by prism exercise.

When these exophoria cases begin to lose the power of fusion the vision deteriorates and amblyopia develops. On the examination of the fundus by the ophthalmoscope it is seen to be dull or foggy. The optic nerve, or papilla has lost its pearly luster, yet it cannot be said that there is neuritis. It seems to be a deposit. As the wayward eye is brought in by the exercise the object light gets brighter and at last vision is brought to nearly normal at about the time when parallelism is obtained.

In later years I have called the attention of the patient to the relation of the two lights, in the general run of patients, as to brilliancy, and found there is a difference in the two images produced by the prism, and they remark, as the treatment progresses, that the dull light is increasing in brightness. The strongest eye—the dominant eye, holds the light of that eye still, while the weaker brings up the light divided by the prism, to fuse. I ask which eye moves, if there is doubt about it. I throw the red glass over one eye, which will enable to distinguish. Then I ask them to tell me when the light moves the other side, or in the other direction, to let me know. When this occurs, which it often does, the interpretation I give it is, the dominating eye is transferred to the other eye.

There is much in the problem of the dominating eye in

orthoptic treatment. It is a very significant fact which not only shows the efficiency of this system, in restoring strength, but gives weight to the theory of debris in the tissues, which interferes with, but dulls the retina, and this process of prism exercise clears the media.

The Kratometer in principle and adaptation is a tower of strength with which to appeal to the weakness of that most subtle and recondite function of ocular orientation; not brilliant or pyrotechnic in its operation; unobtrusive, capable of doing much good, and must be handled with brains to prevent abuses. The possibilities of the system in the future, in careful hands is problematic, but I also believe that it is very great, for the service to which it is put is a new conception of the disorders which have been but little understood, and the time of one man's experience is not enough to determine all the facts in so great a problem.

Dr. Ranney's conception of asthenopic condition was, that the findings of Dr. Stevens in his system of heterophoria, in which there is a disturbance of the normal rotation of the balls, was not merely a displacement but a pathological struggle between antagonistic muscles—the stronger over the weaker, which produced the neurotic symptoms. This was named "imbalance." His remedy was to bring about balance by weakening the stronger muscle by tenotomy. This removed the symptoms, but we have no means of determining the ultimate effects on the function of orientation.

The use of the Kratometer is to restore the weaker muscle to harmoniously work with the stronger one, which is in my hands as successful in removing symptoms as Dr. Ranney's operation, and we have then a normal pair.

A few facts given in the handling of these cases is worthy of notice and is surprising in this connection,

when we read of the rest method. I have treated a large number of school children, some of whom were suffering from inability to use their eyes as others of their classmates. Some of these had been going to school and would get all they could by listening, and on arriving home would lie on a lounge with hot cloths on their eyes, while their parents read the lessons for the next day.

I have taken these pupils and treated them, either before or after school sessions. None of my patients have been forbidden the use of their eyes while under treatment. My instructions have been to read moderately and as soon as fatigue or pain arises to quit.

I have found, occasionally, that one of these omnivorous readers would read hours between treatments and one I found had read a book through while under my treatment.

I have used medicines only in one or two cases, and that was a dinner pill for costiveness.

Occasionally I see allusion to the necessity of developing the *fusion* sense. One of the most interesting facts I have observed, is that I have yet to find a case that has no fusion sense. It is a quality that seems to be implanted in the human frame that cannot be put out. It may be feeble but it is there ready to act. In actual paralysis it may be lost, but paralysis is a rare disease and don't come under this discussion. There is no branch of ophthalmology that is more satisfactory in its treatment.

STRABISMUS CONVERGENCE

I have conquered every other anomaly of the extraocular muscles to my satisfaction but the strabismus convergence. There are several elements in this that make it a problem of its own. It is a frightful deformity, one of the consequences of the human above the lower animals.

Its intimate association in the convergent act, the labor with which civilized man has burdened himself in labor of his eyes, over that of lower animals which is probably ten to one, and which has brought on him so many painful disorders, from which the lower are quite free.

Although this is seemingly a true statement, we have attended to the associating anomalies and been satisfied with treating them as deformities, when there is no doubt they are the keystone of the whole arch of ocular orientation.

Besides the extra amount of action of these lateral muscles, we have to consider in the study of that particular condition, we have almost invariably an amblyopia to deal with; and again the early appearance in life, when we are unable to obtain a co-operation in discipline of the muscles towards a restoration.

The fusion function which is born with the child, is not called upon to establish equilibrium, before the malposition is brought about and when the child is old enough to understand, there is such an amount of amblyopia that it is difficult to make use of what is left for the needed training the situation demands. The general consensus of opinion in the profession is that of a clonic spasm and when a convex glass fails, tenotomy is resorted to. But I believe it is a weakness of the abducess, and believe it can be relieved on this principle.

Worth has some good ideas in these cases. I have had a large experience in the operation for squint in Iowa, but of late years, in the midst of treatment of the muscles, I came to the belief that all of the conditions of the muscles which we designate squint, can be made whole by discipline of the muscles by orthoptic treatment, but in strabismus convergence I have not had experience with it in muscle training to speak emphatically. This condition is apparently different in its physiological

aspect, associated with accommodation in action for combination of function and through the association of the third nerve. Then the peculiarity of its opposing muscle, the abducens has an idiosyncrasy—a separate nerve, the sixth.

I do not find any opinion in the controversy of squint, leading to the idea that it is from the weakness of this muscle that strabismus convergence is produced. It is always from an undue strength or spasm of the internal recti.

From my experience in treating esophoria (latent, some authors call it), I believe that convergent squint (esotropia) can be eventually corrected by muscle exercise.

Worth claims success with the amblyscope as we will see in Chapter VI.

There will be a necessity of breaking up the close relation of accommodation by some means of atropia. The most serious situation in dealing with it, is the very early inception of the anomaly in a child before the age we can put it into training, and during the years between the first appearance, and that in which a comprehension of the child is developed sufficiently to introduce muscular training, the vision is deteriorating all the time. However I have full belief that this anomaly can be subdued by discipline of the muscles.

It would be very much out of character in one who would attempt to teach, not to give a word of caution in the lesson, if by experience he has found danger on the road he would lead the unwary.

In handling the muscles of the eye there is danger of doing mischief, and making things worse rather than better. We know something of the benefit of training our youth in the regular discipline of the camp. The motions they go through in the manual of arms are gone through in daily work before, but the system and the

regular actions towards a given necessity and the stress put upon deficiencies found are what brought the awkward citizen to a soldier's mein.

Can we not see the liability of this system of eye muscles in their delicate construction and the service demands put upon them, that they should get weak in some parts and throw the service out of gear and entail discomfort or inefficiency, or draw upon the nerve supply unwarrantably in performing their duty.

We have been given a standard of refraction. We have been told what equilibrium of the muscles is. We have been given no standard of the function of orientation in action.

We are told the muscles are built for speed more than for strength. But we have no test for speed, strength or endurance of the apparatus for those who would enter school, avocation or guides in public conveyances. So this most important function is yet to have a standard.

These muscles are different in character from the muscles of the body; then the process of inducing them to work is itself little understood; the "wall to wall" and the convergence actions which were used aforetime are dropped out of the curriculum of prescription.

These muscles can stand only so much in kind and time, and it is for the surgeon to learn when and how often each subject can stand.

In 1905 I examined the eyes of 512 pupils in the schools of Des Moines and made a report of the examination in my *New Findings of Ophthalmology*. This study gave me opportunity to acquaint myself with many obscure questions. But at that time I was not sufficiently versed in the office of the muscular apparatus to fully get the benefit of my opportunity. If I did that examination at this time, I could make it of greater value to the cause of good eyes for those who had entered into intellectual

improvement. I had then in mind the questions of vision, refraction, -phoria, duction, balance and symptoms. Such examinations would now be: whether one is able to meet the requirements of ocular orientation, and the endurance of the protracted course of study, and if not, what obstructs; what is the weakness and what should be done to properly equip?

Orthoptic treatment is said to have been tried and declared to be a failure or not fully curing these cases. This comes from the method of manipulation used in disciplining these muscles, which in the best way I have seen them used or described in print, all come short of getting what is possible, because of there being crude, awkward and inefficient, and highly unscientific and unworthy, even of an engineer.

Fifty years of engineer repairing; refracting the rays, tempering the light by colored glasses, shortening or lengthening the guys and links in a misfit machinery, tinkering with nature's finest muscular constructure, is not a high conception of the apparatus of so great a function as that of ocular orientation.

CHAPTER VII

EXPERIENCE IN TREATMENT OF CASES

It will be remembered that I treated the muscles of the eyes of those complaining of eyestrain or asthenopia for at least a term of twenty-five years, working the muscles by prism exercise, believing that the trouble was from weak muscles, and that by restoring the strength they would be completely relieved.

I did not ignore refraction but gradually came to the belief that in young persons, say under 25 years of age, that when the vision was 20/xx or even 20/xxx and the hypermetropia was less than one dioptré and the astigmatism .50 D. with the axis horizontal or vertical, they did not need glasses, if the muscles were in order. I treated on this plan for many years, and was very much surprised that many cases afflicted with the syndroms designated *neuraesthesia*, *migrane*, *neuralgia*, etc., were entirely relieved, and I was obliged to regard them as *asthenopia* under other names.

I will relate my experience with a few of these cases that belong to this category of ailments, that have gripped and made a tragedy of life. They baffle the profession, and some have been the subject of the physician calls dragging on for years, with no abatement of attacks and often have worn out their lives and died from nervous exhaustion.

In the year 1891, there lived next door to me, a woman who had been an invalid for years, suffering periodically

with sick headache, although of healthy stock, she was unable to do house work, and her sickness in many ways drew heavily on the income of the husband. At times, especially in the forenoon when the sun was shining on that side of the house next to mine, I would see her in the window with a hand glass, writing poetry. I fitted the husband with compound glasses, which were satisfactory, and I mentioned to him that I believed his wife needed glasses. He replied that you could never put glasses on her! She was of the Holiness Faith, and was strongly prejudiced, "The Lord had not told her to get glasses." She was attended by a physician of the homeopathic persuasion for years. His brother living in the same city was an oculist, but he was never called in.

At that time I had not associated sick headache with asthenopia. But about fifteen years from the time I first noticed the habits of my neighbor, a woman, aged 32, came to me who had suffered twenty years with all the symptoms of sick headache. When a girl going to school, she would come home and go to bed immediately, but she was kept in school, going through the lower grades. A few years before I saw her, she had been living with her husband about 30 miles from St. Louis and had been fitted with glasses at the office of one of the most noted oculists of the country. She said she had been to his office at least twenty times, and fitted often. Whenever she made the trip and returned, she had to go to bed in a dark room.

I put her on the muscular treatment, and she progressed slowly, but surely, to the standard of duction, and had no attack of headache while under treatment. About the time of finishing this case, she broke one of her glasses, which was a compound glass. It was two weeks before she obtained another, when she refused to wear them, as she was perfectly comfortable without

them. The last time I saw her, she had been three months free from any attack of headache.

Not long after this experience, my sick headache neighbor came to me to be examined, and I found she had 3.D. of hypermetropia, vision 20/xx. She was then 65 years of age, and I put on 3.S. for a distance, and 2.D. in addition for near. She refused to wear them. I urged muscular treatment. But this she refused. She died in about a year from this time, worn out by asthenopia!

There are several other syndromes, I have worked out in a similar manner: *neuraesthesia*, *chorea*, *hysteria*, *locomotor ataxia*, *goiter*, *nervous prostration*. I have had examples of these so-called diseases and completely cured them by muscular exercise. I am yet skeptical as to these diseases being anything but syndromes *masquerad* in *asthenopia*. My experience in the matter, I admit is not sufficient for such a conclusion.

The reason of such a variety of symptoms in apparently in the same condition for cases, and is explained in Chapter IV.

There are many with weak muscles, and others with deviations, that have no headache or pain but are inconvenienced with the slowness of action and loss of confidence in movements, and get no benefit with glasses, that need simply the restoration of the function. There are others in which the symptoms are so obscure that they are unable to describe them but show irritableness, irascibility, but are not classed *neurotics*, and require a vast amount of self control. Physicians cannot find organic disease, and many of my patients have had a lecture on self control given them.

I have reason to believe that many are consigned to asylums who have *asthenopia*, for among the syndromes there is a grouping of disturbances of the mental faculties. They are generally there without a diagnosis. Sanita-

riums house them. A very common mark of the feeble-minded is a turning out of one eye.

These asthenopes have given rise to the many systems of medicine we have in the land—'pathys, 'ologies, 'isms, and even cults of religion.

Seasickness comes from the inability of this apparatus to "keep up" with the increasing motion on board ship; not only are objects in constant motion about them, but this is increased by themselves being in motion. We all know that the first few hours aboard ship, they enjoy the motion, but the first night they are attacked and are not at breakfast table in the morning. My experience, in treating people to prevent sea sickness, is limited, my residence being inland.

EXOPHORIA AND EXOTROPIA (WALL EYED)

This very common condition of asthenopia troubles demands further explanation than that given in a former chapter.

My experience in the treatment of this condition is very gratifying, and one of the greatest experiences of my life.

The treatment is simple in theory, but in practice, difficult from the complications found in this condition. An eye may turn out horizontally, but usually in addition to turning outward, it lies in the socket upward or downward from the line also. Then the amblyopia reduces the vision to mere perception of light, and the eye may be blind. There must be perception of light to call up the fusion sense. The kratometer provides for these conditions, save the last. Formerly I operated on these cases, but the "advancement" of the muscles is a great disappointment, for in so doing the muscle is not strengthened, as it is in the use of the Kratometer, but weakened. I have operated on one case three times. It was a failure,

and every one that has practiced this operation, knows that it does not restore the eyes to the true function. I have been successful in these cases in muscular adduction, if they remain under treatment to get to the standard required.

The importance of the subject of exophoria, and its remarkable prevalence, will bear repetition. The actual simplicity of handling these cases when the proper means are applied, and the great need of the full understanding, is sufficient excuse to dwell upon it, and try to bring all the facts, pro and con, regarding it.

When "insufficiency" has progressed, so that the eyes are departing from parallelism, the condition is denominated orthophoria. The dominating eye holds fast and the other takes position where it can. To fuse then, it calls for more excursion and a greater draft on the nerve-power, and usually there is headache or nausea, and there is double vision, the object being crossed. If red glass is put over the deviating, the image of the projection is found on the opposite side. Some cases will turn the face towards the weak eye to aid the fusion act. In other cases, will close one eye to avoid double vision, or learn to suppress the vision of the deviating eye.

The combination of a prism in their spectacles, or a decentering of lenses, which is the same thing, is prescribed. This is a very common method and is very deceptive and likewise dangerous, in that it relieves the double vision and gives comfort for a time, for the rays are bent to more easily for fusion, but this is an indulgence, a crutch and more prisms are required to get the same relief, which all helps on its wayward course.

The danger consists in displacing objects looked at, and therefore steps are not certain. They reach that point when the prism required exceeds the practicability

of its use and fusion is given up. Operation is then the only recourse offered.

When fusion is given up and the eyes turn out, and is useless the symptoms of asthenopia subside, and they believe they are getting better, and often these subjects return to their avocations, but they are one-eyed people and are debarred from many occupations of good remuneration, together with the great deformity of the face.

The matter of suppression of the vision of one eye, spoken of in this chapter. It is the power these cases have of blinding one eye to get rid of double vision when it occurs. The habit is more prevalent than is supposed, and the patients themselves are not aware they do it. They are then one-eyed men. This habit is troublesome in treatment of duction, and sometimes there are long delays when the patient will lose the object in that eye. I am inclined to believe that this habit of suppression is common, when there is no exophoria. The quick action of fixing is demanded but there is some obstruction and double vision occurs which must be gotten rid of, and this is the way it is accomplished.

In closing this chapter, I will enumerate a few cases, some of which are reported in *New Findings of Ophthalmology*, to show the variety of symptoms found in muscular asthenopia and the different occupations from which they come. A young preacher became a book agent because he could not study. The treatment of his eyes fifteen days enabled him to return to his chosen work. A dentist played the trombone in an orchestra at night; one evening everything turned black before him and he tumbled off his chair. He was put to bed and dosed for billiousness. The treatment of his eye muscles cured him of asthenopia although he had tried glasses, and he is now at his former work. An electric worker who did

inside work, was no longer able to stand on a ladder. His physician doctored him for three months for indigestion, and then told him to consult me regarding his eyes. He was surprised and declared he had good eyes, but he came—Vision 20/xx with orthophoria, but weak duction. In less than ten days he went to work and remained cured for two years at least, when I lost sight of him. A miniature painter who had learned her art in Europe, opened a studio in New York City, broke down, closed her studio and came to Iowa, and for two years could do no palette work. In thirty treatments I cured her and she opened a studio in Chicago and took the prize for miniature painting in Philadelphia.

A poor woman over fifty years of age, could only do kitchen work; gave up reading for years. Treatment of a few days enabled her to read. During the treatment of her eyes she asked if I cured rheumatism with that instrument. She had had cramps in her toes and folding of her fingers, but since treatment of her eyes she was free from it. A ranchman was troubled with intolerance of light; wore black glasses out of doors. In forty treatments all at once, nearly at the end of the treatment, he found he could go in the light without his coquills and throw back his hat without discomfort in the sunshine of Oregon. He remained well when I last heard from him, six years after. In one case treated for weak muscles and lid congestion, attained to standard of duction in twelve treatments. One year after she reported that a goiter she had had for years had disappeared.

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CHAPTER VIII

GETTING NEAR TO FUNCTION

Readers of this book, if interested in the topic will be pleased to learn what others have thought out the same line. I therefore take pleasure in recording the expressions of some of the profession who have come near to recognition of this function of Orientation.

Dr. Noyes remarks: "The maintenance of correct binocular is the necessity which dominates the ocular muscles." *Diseases of the Eye*, p. 133.

"The possession of two eyes confers an equality of sight which is not only more effective than with one only, but is also of a different kind. With two eyes not only does the brain receive a double impression, but each eye views an object from a different point and receives a slightly different image—a cube a foot square, at ten feet sees it under different perspective, and while its form is evident to each alone, the combination of the two images gives what is called the sense of relief or depth. * * * The movements which the eye makes are regulated with extreme nicety and are capable of very fine adjustment. *Ibid*, p. 135.

Professor Fuchs of Vienna in his first American edition (1892) says: "Orientation in space * * *, i.e., the ascription of objects seen to the place where they actually belong, and that by virtue of one's sense of equilibrium the muscular sensations which originate in the ocular muscles, and which inform how our eyes are directed with relation to our body."

Oliver says: "What we are looking for in the study of the subject of extrinsic muscles, is a principle or a base on which to work, such as Donders revealed regarding the intrinsic muscles. There are certainly some general principles that will encompass the problem."—*System of Eye Diseases, Vol. IV.*

Volk says: "In the study of the action of the ocular muscles, the fusion power of the eyes is of the first importance. I notice that it is practically ignored by most writers on the mobility of the eyes, yet, in all our clinical work it is the most important factor, as it is necessary for the function of binocular vision, as we must have perfect binocular vision, both at the near and distant points."—*Strabismus or Squint, p. 16.*

I make no apology for turning to the symposium of papers and discussion, and taking the space in this book, of the late meeting of the Medical Association in June, 1919, and excerpting from the address of Dr. Charles P. Emerson, Dean and Professor of Medicine in the Indiana University School of Medicine, Indianapolis, Ind. A general practitioner who, it seems, has given much thought to class of neurotic diseases which belong to ophthalmologists to relieve. Some of the syndromes mentioned are very prevalent in the oculist's office, which are not cured, and they get back to the general practitioner, and the object of the conference, it was stated, was to get a more combined study of these cases.

At this section of Ophthalmology of the meeting of the A. M. A., June 11, 1919, Prof. Charles P. Emerson, M.D., read his paper entitled "*The Ophthalmologist and the Physician.*" He said: "Twenty years ago neuraesthenics were not treated well by the profession, for they did not understand them, and they were driven into the churches where they received more sympathy. We can now help many of these, and we have learned that we have

found that they had no organic trouble, but are in some cases handicapped by some mental or physical defect, leading to nervous, or even to mental breakdown." He invites the oculist to discuss it with him. He refers to eyestrain, but would avoid emphasizing eyestrain as the sole cause of any symptom, but "more likely to be in the neurotic disposition of the patient himself." He considers the oculist as a refractionist and he should join the internist and give the proper treatment. Headaches result from eyestrain, by no means all; the pain in or near the eye following close work; complex headaches seem to depend upon gastro-intestinal disturbances; so-called "sick-headache," "bilious headache" are well systemized syndromes; they are truly illnesses, periodic, due to a chain of causes, the patient himself, not the eyestrain, is chiefly to blame for the paroxysmal headaches, like the periodic chills in malaria, may be interpreted as defensive crisis, one point I do insist though, they may be the result of eyestrain; they are not due to eyestrain alone. First in eyestrain headache, the pain is superficial; nasal headaches and intercranial, are deep. Second: Skin is hypersensitive, photophobia. Third, during a nasal headache there is usually demonstrable a slight functional mental reduction, but not in these. Fourth: Reflex phenomena are common; vaso dilatation of the temporal artery on one side; nausea and vomiting; blepharospasm, etc. Fifth: Cerebral symptoms may occur * * * paralysis of the external rectus muscle. Sick-headache belong to * * * adolescence and young life; period of close eye work; they end when the functional activity of the ciliary muscle ends.

"In addition to headache many other phenomena * * * which occur under similar conditions. We may call them headaches equivalent or painless headaches. They occur at any period of life, but in childhood and youth we see

them best. A child of six years just beginning school may have attacks of bad temper or depression which perplex the parents; some have crying spells after school; some children will lock themselves in a room or crawl under the bed. These painless headaches are well illustrated by some children during automobile rides. They are called "poor travelers." They enjoy the ride at first but soon get unruly, disagreeable and cross; they "hate the ride"; they "hate everybody in the car". Such attacks of temper and depression in children may be nothing but headache equivalents in the child. When those giving this history from 14 to 18 years of age, typical paroxysmal headaches often begin. * * * Paroxysmal sick headache is replaced by one of its equivalents, usually a more constant, less severe, duller pain which the patient describes as "neuralgic" with fewer reflex disturbances and no nausea nor vomiting. In still other cases the equivalent is not a pain, but a definite psychic depression. It occurs in women and men, each depressed patient of this age who gives us no history of past attacks of mild depression and no evidence of developing organic brain disease (paresis for example) should be referred to an Ophthalmologist. * * * I would repeat * * * that a change in the character of the headaches or the appearance of headaches and of psychic equivalents is good evidence of life-long eyestrain.

OTHER RESULTS OF EYESTRAIN

Headaches are by no means the most important of common results of eyestrain. The eyes are organs of pain and sense as well as of vision, and eyestrain patients of the hypersensitive type dislike the glare of the sun on the snow or on the water; they dislike brightly lighted rooms; hypersensitive to certain colors or combination of colors. Second, the eyes have a sensitive and delicate

motor apparatus. Certain sensations, such as the ocean and the seeming movements of the walls of the room, seem due to a periodic relation and spasm of the muscles of the accommodation. Train sickness, dislike of moving pictures, to a certain degree, seasickness (though this is evidently a very complicated phenomena). The feeling of floating in the air, spells of faintness and especial dizziness or definite vertigo * * * probably associated with disturbances of the motor apparatus * * * Many nervous and mental symptoms with which eyestrain patients suffer may be due in part at least to the eyestrain. Some I have mentioned. To them may be added: Discomfort caused by certain color combinations and by certain patterns; wall papers if the design is in pronounced stripes; confusion in a word; a sense of unreliability, as though the person were drifting into space; faint attacks; drowsiness on close eye work, probably nature's method of protecting the eyes while the reverse is true. Many a case of insomnia has been relieved by proper glasses. Not all of these may be the result of eyestrain alone, but eyestrain patients certainly do have them and often gain relief if these glasses are corrected.

But eyestrain has some more important effects than these. It may help explain certain phobias.

The first of these is the result of uncertainty of balance. One gets considerable assistance in diagnosis of a doubtful case, by inquiring concerning the sports of childhood. "Could you," I ask the patient, "when a child, run on a stone wall?" "Would you run on a plank over a brook?" "Would you run over a railroad bridge on the ties?" "Would you play tag on the rafters of a house partially built?" If the reply was No! I ask, "Do you remember definite instances when your friends would do these things that you positively would not, or when you hesitated so much that your friends commented on your timidity?"

This symptom may persist through life. The dislike of looking down from a high point, or walking on the edge of a height is common to many. One man, a good sportsman, told me that he could not bear to walk on a log over a brook, and would always find an excuse for his friends to go on ahead so that he might crawl over unnoticed, on his hands and knees.

The explanation of this fear may be as follows: When you walk on a broad smooth sidewalk, it makes little difference where the feet are placed, the length or width of our steps is unimportant. But when crossing a brook on a plank the feet must be accurately placed. * * * It would seem as though the mind of that wide zone of unconsciousness the eyes do not give me data accurate enough to guide the muscles of the feet, and the language in which this mind speaks to us is that of fear. It is not height itself which worries these persons, for many a child who will refuse to walk on top of a wall, will take great pleasure in climbing to the top of a tree. In the latter case the muscle, or better, the joint sense, is brought into play, while in the former the muscles are guided chiefly by vision. A related phenomenon is agoraphobia, or the fear of crossing an open square or street, especially if that street is a busy one; and this would seem to be a very wise and salutary protection.

INHERITED OR FAMILY HEADACHES

A pain or strain we do not believe can be inherited, but the anatomical conditions that lead to eye strain, certainly are inherited; physical resemblances, and tendency to headaches or their equivalents may run together through two and three generations. I refer to the actual shape of the face; it is likely that eyeballs of similar shapes may be assumed. If of several brothers and sisters two or more have headache which the others do not, and

if one of these parents prior to 45 years of age has headaches, it is not unusual that these two or more children will resemble each other and this parent more than they will the others. Vision is not merely a physical problem; it is more a neuromuscular problem and we pay dearly for it. The muscles of the eye are small but the fatigue that they can produce is certainly great * * * the problem is indeed to help the patient to see better; but the greater problem to see more cheaply, that is with less strain, some already have vision better than the average and are wretched; many a patient has been driven to distraction, as they say, by glasses which improve the keenness of their vision. * * * Unfortunately for them, they see well with each eye. Their trouble is usually a slight defect which does not disturb vision, but which does make vision expensive in terms of strain. If they had a greater defect in both eyes, there would be less strain; if one eye had a much greater defect than the other, there would be much less strain. But two keen eyes belonging to a neurotic patient, each with 20/15 vision with, for example, slight hyperopic oblique astigmatism or slight muscle imbalance, can keep their owner in pain and even in bed in a sanatorium. The internists therefore beg of you to fit your glasses to the patient's nervous system as well as to his eyes.

In this address we see a man in general practice, who has had opportunity to study the field of the oculist, and thinks there must be other causes for eyestrain than errors of refraction, when there is good vision but the patient is unable to use his eyes, but like the oculist himself don't know where it is. He describes, graphically the disabilities of the patients, with great insight and portrays symptoms which refractionists see but which they scrap-basket and excuse themselves from analyzing or attribute them to any cause but some unfound error of ametropia.

One significant foreshadowing is apparent in this address of Dr. Emerson, in which he has gathered one of the best descriptions of the symptoms and characteristics of troubles of defective orientation, yet in print in medical literature, but evidently has no idea of attributing them to this binocular apparatus; nor did any one present catch the vision of it. But it was hovering over them. It is in the air, and will be materialized before long!

Other papers read at this symposium and the discussions do not lead one step beyond what has been rehashed whenever eyestrain is discussed. So far as this discussion appears in the transactions, not one response of a helpful nature was made to Dr. Emerson's appeal.

The same disposition prevails to ferret out a cause in the general system when not relieved by glasses.

CHAPTER IX

OCULAR ORIENTATION

MEANING; ITS OFFICE; ITS SIGNIFICANCE IN THE OCCUPATIONS OF THE WORLD'S WORK

One of the surprising omissions I find in Ophthalmology is the paucity of knowledge or observation these writers show in the attributes of the sense of sight and its dependability in the affairs of life.

In all the piles of literature on the subject of the organs of vision; the wonderful scientific explanation of the organ as a mechanism; the care of it in correcting its optical defects; the saving it from destruction by accidents and wrong uses; the restoration from damaging influences, there is very little said of its office in the service it gives as a function; its significance in the participation in the finer qualities of enjoyment that give tone and enthusiasm, sprightliness and vivacity in motion. They have missed the poetry of its use, in its ability to promote the arts and sciences; in the skill and efficiency in mechanics, engineering and landscape gardening. They have forgotten, if they ever thought of it, that its perfection is the sign of the love of life; giving buoyancy and vivacity of spirits; larger confidence in the initiative; keenness of observation; appreciation of form and contour of animal grace, symmetry and proportion.

Ocular Orientation is the consummate function that presides over the binocular muscular apparatus of the eyes that bring to the images seen, one by each eye into

one image, and performs this act in all the fixations of the pair of eyes. "The maintenance of correct vision is the necessity which dominates the ocular muscles."—Noyes.

This function was named by Prof. Fuchs in the first American edition of his book, 1892. He does not designate where this union of objects takes place; whether in the brain or on the retina, which in controversy in physiology of the eyes, but it seems very easy to decide when we know that double images on the retina are confusing to the brain. The brain can only use a fused picture, and to make the single picture by the two eyes constitute the office of orientation. This is an hypothesis, it is true, which seems not necessary to be settled immediately, if we recognize that the normal vision is the fusion of the picture of the two eyes. As soon as we recognize the act of fusion of the two images of the two eyes, and that the brain receives the single object, and that the binocular apparatus is the controlling moving force of it, it can be understood as a function.

Here is a perfect organism found only in the human species, that presides over every motion, from the first step in childhood, to the last handshake of the aged; it gives to the young the means of making life a joy; it provides skill for the middle aged to gain a livelihood; it furnishes the elder the instrument with which to add to his knowledge.

This function has to be acquired by experience; the young child sees double and cannot fuse the two objects he sees. He grasps at objects that are out of reach.

Flint's Human Physiology relates the case of Casper Hannan, who was kept in total darkness and seclusion from the age of five years until nearly seventeen years old. The appreciation of size, form and distance had to be acquired by experience. Flint, p. 804.

For a clear understanding of the function of Ocular Orientation and allocating it with faculties that are closely connected in the act of vision we will separate these faculties with it which are often confounded in describing vision.

Orientation includes *projection* and *perspective* or at least the first cannot act without the other two, but all three have the particular part.

Projection has relation to the focal apparatus, the transparent media, the crystalline lens, the cornea, and the regulation of light by the iris. The system of refraction and accommodation has the care making definite and clear the object, both far and near, and the ease of its service. This is a congenital faculty; a child does not have to be taught to see.

Perspective is a binocular vision gotten by the system of extrinsic muscles and is governed by it. The images received by each eye are fused into one by the muscles excited by the "fusion sense".

In the normal performance of the several acts comprising orientation, one faculty is seldom considered by writers on the eye, which is the speed with which the acts are performed. The speed with which the acts of orientation are performed has never been measured, to my knowledge. The time the eye takes to cross the field of vision has been attempted.

The wonderful attributes of this function to measure and allocate distant objects and to converge on the infinitesimal is furnished with an apparatus to accomplish it so exact and capable that before we knew the function it controlled we were awed at its mechanism and adaptation. But to fully appreciate it, the larger view as a pilot to inform the brain to pass judgment must be adopted.

It has been observed that hypermetropia runs in fam-

ilies, and is found among the illiterate. A parallel condition is this genetic insufficiency is found in the converging power, as well as in the focal apparatus. The rural portion of the country where labor is mostly at arm's length or beyond, are seeking knowledge. The farming communities are sending their children to school and to colleges; the sudden change on the muscular apparatus is severe and they often break down.

The higher attainments of man are gotten by studiousness and assiduity; this means a continuous draft on the binocular apparatus. Many young persons are dashed in their ambitions for a professional career by this incubus, and have to change their whole course of life. American people read much; the modern inventions are concentrating labor on a few muscles; the service in attending of the machines—for instance in attending a printing press, gives very little play to the muscular system, and this function being the chief reliance for guidance, is soon worn out.

The symptoms I have come in contact with, I prefer to classify as syndromes and are the reflexes described in Chapter IV. They are grouped in this fashion very frequently in the muscular anomalies and when relieved by treatment "leave in a body" with no after effects.

When I realized this manifestation of the phenomena to be not really disease but a masquerading of it, I wondered what I had found.

It seems extraordinary that in this day it is necessary to describe this function called Ocular Orientation, which presides over the apparatus which plays such a conspicuous part in life; its entity in Ophthalmology and the attributes belonging to it in health and disease; the seat of its disorders, and why it is not in the forerank of other branches with which the oculist has to deal.

For if I am not much mistaken in the weakness of this

function lie two-thirds of the symptoms of "eyestrain" and the proper attention to this apparatus of binocular single vision will relieve thousands of that octopus of human ills called asthenopia.

In not recognizing this function as the goal of our achievement for best vision; in not making its supreme office the chief object to be attained; in not discovering the proper means of putting into easy and normal action, this most dependable function we lose much of the significance of our specialty. The want of understanding of this supreme division of ophthalmology, fills society with invalids; the disabled are many; some laid on the society shelf; some going about with a "cast"; some with tinted glasses; some with horrible distortion of the face muscles, and unnatural aversions of the face and carriage. All because of disorder of this function. It is a travesty on the profession!

The estimation of the value of this newly named function in health, has not been portrayed. Pairs of good eyes that fulfill all the requirements are numerous, but the faculty which has enabled one with perfect eyes to attain uncommon position, or has accomplished rare deeds, seldom attributes it to his good eyes.

The safety to our person, and the ability to perambulate amongst traffic without accident, depends upon this function, and the accuracy of its apparatus; manipulation of most every kind calls for guidance in it; freedom of motion, vivacity of spirits, love of observation demands its best service; judgment in symmetry and proportion cannot be had without its perfect work.

Healthfulness, love of life, desire of seeing, craving for out-of-door sports, walks, love of rides, and love of travel depends largely on this wonderful function of "binocular single vision".

How perfect must be the orientation in the trapeze

performer, the tennis player, the baseball player and the billiardist!

Any one who operates an automobile should know whether this faculty is sound. Every engineer needs to know whether this faculty is perfect; it is as important as the color sense.

Again let me make more clear, the difference between a person with good orientation and one that is defective. Very few who have observed the differences in the manipulation of people, attribute the awkwardness of some, to the eyes, but in most cases there it is. One with good orientation, other things being equal, has a directiveness of motion; they at once put their hands to the desired place; say to pick up a pin, to thread a needle, or in playing a game of chess. Those using only one eye or when fixation is obstructed or slow, may make two or three plunges before they accomplish the purpose. This loss in time and muscular effort, when reckoned in a day's work is enormous. If this very common shortage in efficiency is understood and explained by the oculist and rectified, how much service he can be to the wage earner.

We have a word in the science of optics, which has been laboriously worked almost out of existence in defining it, but which we need not fear using in this connection. It is *Horoapter*. We will use it to describe the extent of the binocular field of vision, and leave out the intricate phenomena discovered within its bounds. The horoapter is simply the space in which a person can maintain single vision (not doubled). When the head is fixed in the primary position, cast the look to the left as far as one can see singly and then to the right, the lines that would describe these boundaries on the sides, and all the space in front between the ground as floor, to infinity, together with the arch above, is the horoapter of that position of

the head. The function of Ocular Orientation in binocular vision is performed within the horopter. The horopter of some people is very narrow, and to scan requirements in some duties, requires much turning of the head to encompass the field if the eye muscles are not doing their wonted duty. Now to define this scientifically, we will say that in test for adduction, we find there are many who can correct but 10° to 13° of prism adduction (convergence) when it should be at least twice as much.

My attention was called, not long since, to the exposition of the work of employes at machines that are used in business offices.

One of these machines exemplified the use of this function we are elucidating more than others. It was a machine operated by a young woman in cutting or impressing letters on a metal plate for an addressing machine. With the left hand she controlled, by a wheel, a darting movable triangle of red and of small dimensions, on a line where all the characters used for the plates. When it stopped at the one required, the right hand moved a punch which impressed the letter on the plate.

To make the plate that was made while I was there, required fifty characters, and these were all stamped on this plate in 40 seconds. She said she often worked this machine eight hours a day, and she did not complain of its severity on her eyes. The proprietor said there never was an examination of the eyes of the girls who applied to learn this work. They were put on the job and kept at it until they found they could not endure it, and they changed for another. He did not seem to attribute the distaste for the work to eye failure, but rather to disposition or want of stability.

This illustration is one in which the higher and finer requirements of eye adjustment is well applied; it is dependent more upon the easy working of the function we

are specializing, and the ability to perform it is so perfect an example of a choice faculty that is well worth emphasizing and directing the attention to, in order to become a skillful wage earner.

Employees will of course continue their work, unless painful symptoms arise, notwithstanding the shortage of output arising from it, using up the nerve force to its limit day after day.

If the adduction of the converging muscles is kept to 40° or 50° the hand work of these laborers is very much lightened.

In the selection of an avocation or in looking for a job or in the choice of employes; the matter of Ocular Orientation should be one of the first considerations, yet it is not thought of. The cause of the inability to perform the work assigned them may be entirely ocular orientation, yet it is unknown either to employers or employes. If an oculist is consulted there is so little understanding of the binocular apparatus that the patient gets no service except a pair of glasses, and on this he is dismissed. There are thousands who get this makeshift and receive no benefit in relieving their symptoms. There are many out of employment, going from one job to another, not knowing the cause of their suffering. They get sick of their job and fall out from distaste of it, or inability to perform what they hoped to.

From my contact with many such as these described, I believe it to be a very prevalent cause. It is a great stumbling block to self-improvement especially in the line of study.

A very striking example of the necessity of ocular orientation in manual labor is the one-eyed person. One who has lost the sight of one eye is handicapped, and cannot perform many of the requirements in manual labor and other industrial pursuits, and is continually meeting

with small accidents, but learns to go slow and to be cautious. He cannot drive nails with facility. An expert in driving nails expends the blow with the hammer, in the axis of the nail and if the nail slants the one-eyed man does not perceive it, and he therefore is apt to smash it down.

A one-eyed man, not knowing the essentials of skillful labor in this particular, or the deficiencies that his condition entails, he does not understand why he cannot adapt himself to the requirements which his mechanical ingenuity seems to be necessary. Many a man of ambition tries different occupations, and after repeated attempts may fall into one that does not require the function we are describing. The singular thing is that so few are able to give him the proper advice.

A ranchman told me of a man in his employ who, when harrowing in his orchard, was continually barking his trees, and as he regarded him as a willing and intelligent workman, it puzzled him to know why he should be so careless. When I told him the fact that a man with but one eye could not measure distance, he accepted the explanation and kept his one-eyed man on other work. The man changed his employer, but soon left his second place and went to selling stoves.

I often meet with one-eyed collectors and solicitors. A one-eyed man should always carry a cane. No man with but one eye should be a motorman or run any kind of a vehicle, much less try aviation.

The word *perspective* is a term used in the fine arts; drafting and painting and painting upon paper or canvas, to picture on a flat surface in such a way to give depth, color and shade. But there has been no thought that the sense of perspective must be had by every one in his vocations, even by the laborer with his pick, or that it has an intimate relation to one's safety in every day perambulation.

In these days when the streets are filled with fast-moving vehicles we must be better prepared by attention to this function to keep it in the best condition to meet the new order of things and escape the increased danger.

The necessity here is easily seen of requiring the drivers of machines to have this function normal.

Upon this matter I would mention a fact: Fuchs calls attention to a physiological fact (already mentioned) that the image of moving objects falling on the periphery of the retina excites our attention most, and the two eyes in a glance at it fuses the object. This act or succession of acts are thus observed with incredible quickness. May be the fixation in crossing a thoroughfare, say with a child, in two minutes time, is changed a thousand times, and yet the normal apparatus will perform the work, and the person have no thought of any wonderful performance.

This function is wonderfully displayed in the ability a man has, to say nothing of the confidence it gives him, to cross beams high in the air on a building in construction.

The story of the neurotic, the neurasthenic, the insomnia, the breakdown of the willing and ambitious who start out to make themselves efficient and worthy to attain the higher places in the world, and are blocked in their career at the very threshold of their goal, is a sad one indeed; there are thousands of these who are thus stricken by asthenopia; strong otherwise, and yet this subtle incubus lights upon them and their expectations are dashed. The general dissemination of this distemper in society is not recognized, because of the difficulty of description and origin. Its effects are attributed to mood, disposition, idiosyncrasy or other fatuous explanations. It obstructs activity, energy and exertion; it curbs vivacity; it dampens zeal; it bridles the spirit; it eats up ambition; saps aspiration; corrodes vigor; it weaves

the insidious ennui and makes in the end, almost sure, a society scrap. The most lively and free disposition it will curb or hamper; it will make peevish and uncompanionable, the heartiest and most lovely. I have seen and treated young children who had the manners of an old person by this grip of asthenopia. It has turned many a man from a professional career; it has confined subjects of it half of the working hours in bed and a dark room during a whole life time. I have reason to believe that moral turpitude has to do with this incubus, and when it is reflected on the mental it unbalances the conscience.

For fifty years we have worked in this regal presence—Ocular Orientation without knowing the majesty of its prerogative. We have examined thousands of school children and corrected the errors of refraction, believing for a long time that this was the finishing touch in ophthalmological attention. The physiological function in the uses of the two eyes in conjunction was left to the patient to work out for himself.

We have no standard for functioning!

We know not the deficiencies of eye workers!

There are no examinations for employees, where the eyes are the principal function at stake.

A young person has determined to pursue a certain avocation. He ought to know whether he has the right equipment, but he enters into a course of hard study, and often breaks down after a few months, and has to change the whole course of his life, besides the new expense he incurs in finding some one who can explain why fate has been so unkind. There are thousands of the seekers today.

The problem of motoring and aviation, primarily, is in the engine; it depends the reliability of the function of motion. This living principle has been forgotten in this prominent function of the human body, and not only

must the engine problem be solved in motoring the earth and sky, but the pilot's eyes should and must have that principle of life in Orientation.

Without the association of the idea of functional service and its place in the activities of life, we lose the greater important service of the sense of sight in the economy of the world.

And as I believe, this new conception of this apparatus promises not only greater insight for relief of asthenopia, but it broadens the views of Ophthalmology by considering this motor apparatus, at which we have tinkered so long, as belonging to an important function, calling for study of higher attributes and a commensurate grade of professional service for its ease; for apprehension of further necessities in this recondite and highly developed faculty, will require acute observation, ingenuity, and perspicuity; the higher the grade of any function, the more often it is called on, the more complications may be expected.

CHAPTER X

TESTS, ILLUSTRATIONS

It does not seem possible that any one can deny that the eyes have this function of Orientation, but the identity of it has not been presented to us as such or its full office has not been conceived. It truly is the transcendent of all other faculties in the animal kingdom. It measures our relation to objects around us, and makes life worth living; it is that wonderful quality of vision that gives discrimination and adaptation to life; to its superior power over the vision of other animals, its ability to the intellect that which refines, adds beauty to the grandeur of earth; it fashions the crude works of nature and evolves comfort and luxury; to it, not only does its gifts to man enable him to cultivate his mind, but when that intelligence has been acquired it dominates all living things of the earth.

We have no criterion of efficiency of this function!

We need tests of precision to know whether in a given case, the eyes are performing their function in form, speed and endurance.

A standard should be established!

The limit of disability for certain assignments in duties in matters of skill or guiding or managing a public conveyance.

There are several devices figured in the books for testing the behavior of individual faculties. Some very good in principle, but crude in construction. I have attempted

to improve some of them, holding to the design of the inventor, in principle.

First Test—Malibranche's Test



Fig. 1.

Flint's Physiology this very simple test: "Suspend by thread a ring the opening on which is not directed towards us; step back two or three paces; take in the hand a stick curved at the end; then, closing one eye, with the hand endeavor to insert the curved end of the stick within the ring. We will be surprised at being unable to do what we should believe to be very easy."

To make the best use of this test, I would suggest that the ring be three inches in diameter and hung by a wire

to keep it in position. Then have a rack of six or ten staffs of different lengths from two to four feet. The performer to take up a cane and hold it about on a level with his elbow and advance one or two steps and make one horizontal stroke at the ring, then lay the staff on the rack and take up another, and proceed in this way until ten trials are made. The percentage of success or failure can be easily estimated. Care should be taken that the subject does not estimate the length of the staff by using the other hand, or by putting to the ground. He should put the free hand behind him. The curved ends of the staffs ought to be hidden from view also.

I believe that many with good vision, singly in each eye, cannot perform this exercise because of slow adjustment from asthenopia; suppression in other cases.

Second Test—Nail Driving

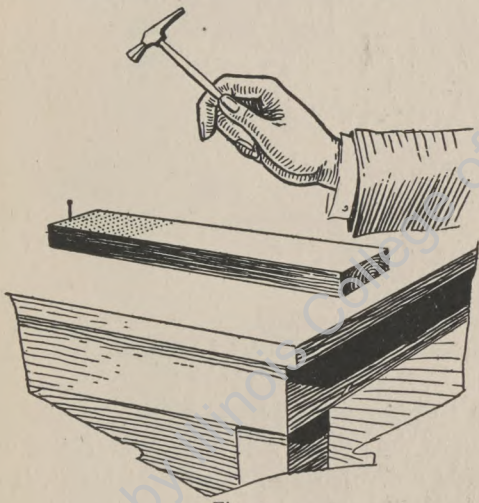


Fig. 2.

Provide a block of wood, at one end line off the divisions by drawing ten lines across the end and as many at

right angles to the others, making squares and at the intersections of these lines drill small holes, just deep enough to hold a nail upright without support. The patient is given a small hammer (jeweler's hammer) and he is asked to drive the nail into the wood without the use of the other hand. Give him twenty strokes. This nail can be left in the block just in the condition he has finished his driving. A record can designate the nail. To have uniformity in this test, the same sized nail should be used, and the same hammer, in all cases.

Third Test—Hering's Drop-Test

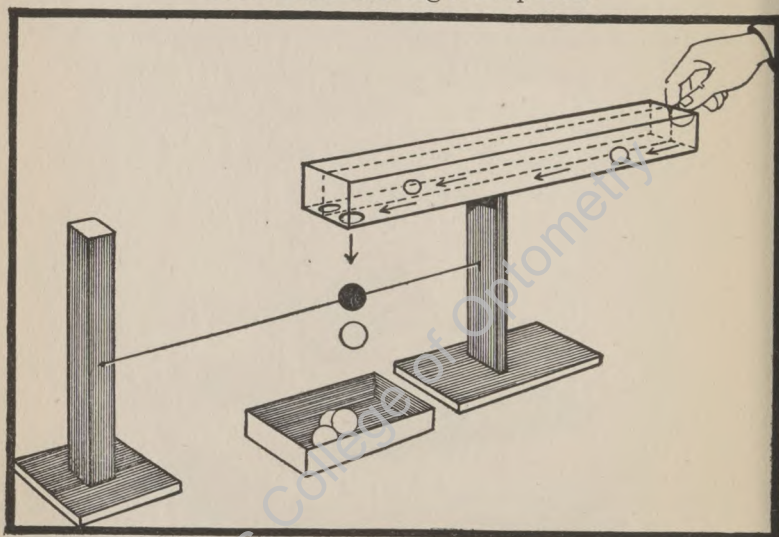


Fig. 3. Hering-Hazen Drop-Test

Hering's *drop-test* as figured in the textbooks is very crude, and as the principal valuable features of quickness is purposely discarded by those describing it, it destroys its value entirely.

I have constructed a modification of this test (Fig. 3) which restores what I think was first designed by its

inventor. A thread with the bead on it is drawn across the line of vision of the subject examined. A marble is placed in one of the tubes by the operator which runs down the slightly inclined plane and strikes a partition at the end which causes it to drop straight down, and the subject designates which side he thinks it dropped by a tap of a small hammer; one tap for near and two for the far side. It is known by the operator on which side it will fall, as he knows in which tube he placed the marble. This test facilitates examination with little labor and gives precision and uniformity. This test seems to fulfill the requirements for measuring distance and speed. Experience will determine many matters of detail not yet made certain.

The four-dot test of Worth (Fig. 4) will serve in de-

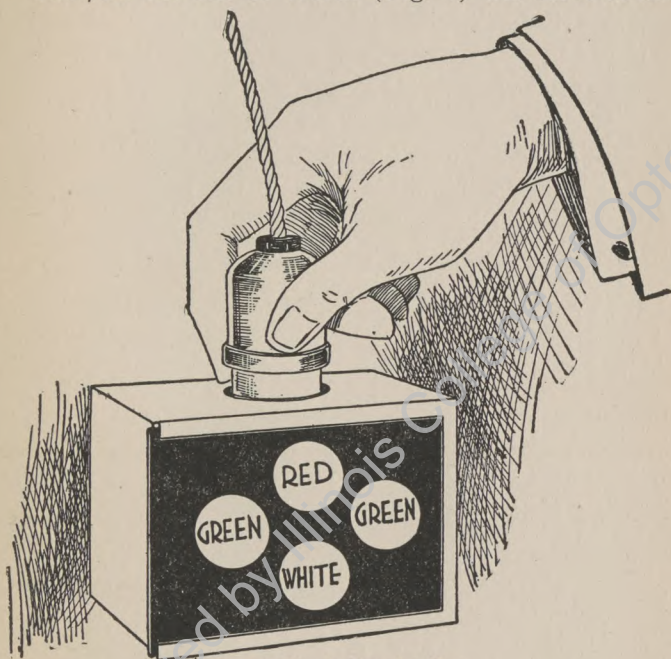


Fig. 4. Worth Four-dot Test.

tecting unserviceable eyes. I am led to believe that there is much suppression of vision of one eye in short intervals when there is obstruction to fusion. If this test proves to be reliable in this particular, it will add much to our armamentarium.

Worth describes its use in his book "*Squint*":

A pure red glass allows only the red rays to pass through it. A pure green transmits only the green rays. Therefore light which has passed through the red glass cannot be seen at all through the green glass, and *vice versa*. The patient standing five or six yards away, wears a trial frame with a red glass before the left. If now he sees two dots (white and red) he is using the right eye only. If he sees three dots (white and two green), he is using the left eye only. If he sees four dots (white, red and two green) he uses both eyes, and has at least grade one binocular vision. If he sees five dots (red, two green and the white seen double) he has diplopia. If the accuracy of the patient's answers be doubted, it may be tested by changing the glasses in the spectacles frame from one eye to the other. *Worth on Squint*, pp. 15 and 16.

Fifth Test—Landolt's Ophthalmo-Dyanometer (modified)

This instrument is a beautiful one in principle. Instead of a paper box with a lighted candle, and a tape measure attached, I have substituted a metal box to slide on the convergence rod with the narrow slit in front lighted up by an electric bulb. The row of small holes that are in the opposite side can be used by turning the box around and sliding as before. With a red glass over one eye, it cannot be excelled for testing convergence and inefficiency of the laterals as taught by Von Grafe. I have not used this for distance beyond a half meter.

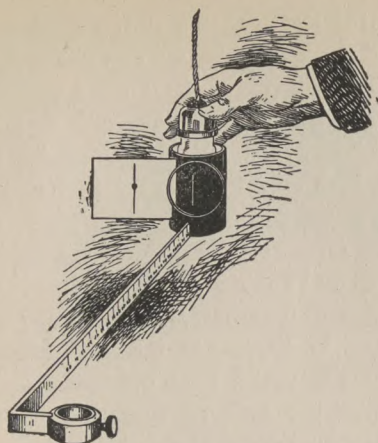


Fig 5. Convergence Rod—with modification of Landolt's Ophthalmodynamometer.

Sixth Test—Prisms

We turn now to test the moving apparatus of the *function of orientation* which I consider the surpassing test of all, by appealing to the muscular apparatus which adjusts the eye-balls to perform their office.

We want to know the strength of these muscles as well as the quickness of them. With prisms we can divide the object that has been fused and deflect the picture of one eye to another part of the retina. when the fusion sense is excited immediately and demands a fusion, *and if the muscles have the ability they obey* and the two pictures are again fused; another prism may be added to it, or one the strength of the two, and the fusion sense being on guard, and the muscles can still act, it is fused.

The ability of the lateral muscles to converge is put at fifty degrees and called adduction. The opposite duction of the laterals (to spread outwardly) is eight degrees and called abduction. The prism power of the vertical muscles to fuse is set at two and a half to three

degrees. If the eyes can perform the fusion act to this standard, and do it quickly, we can pronounce it normal.

A simple experiment which I have described in some of my late articles may demonstrate this duction test. Take a red glass and a 10° prism and have the subject "project" his eyes on a light at least 20 feet distant (the moon in a clear sky makes a good object). First put the red glass over one eye. Sometimes the subject sees two moons, one red and one white. When this is the case they are seldom brought together, showing much weakness and double vision. If there are not two moons as above described, put the prism base out, over one eye, being careful to have the axis of the prism horizontal. If normal orientation exists, the two moons produced are brought together and fused into one. This is done, sometimes, so quickly that the subject does not see two moons that the prism produced. By calling his attention to it and putting it up and taking it away again he will see the double image and its fusing, providing he has two seeing eyes.

Some persons cannot fuse the two objects with a 10° prism before them and they remain apart. If a 5° prism is then put up, it may be they cannot fuse that. There are many that cannot do this.

If any one will equip themselves with the articles described, and take the opportunity at gatherings on the lawn, or at other places, they will be surprised to find how many are deficient in this function.

In office examinations the procedure is more extensive to get the requirements of orientation; the vision by test type; the manifest hypermetropia and astigmatism by lenses, the phoria by Maddox rod test; the dioptries of accommodation and the meter angles of convergence. In all of this we examine the physiological machinery that presides over the function of ocular orientation.

Prisms through the fusion sense excite the moving apparatus to movements that are the same as in the act of fusion in orientation. There is no other adequate method of testing the strength, speed and natural performance of their office, and this function is the acme of visual accomplishment. By this also, I emphatically reiterate, we have the only true common sense method of curing the many ills connected with it.

I say this with confidence after my long experience in the trial of it, and notwithstanding that prisms and prism effect in ophthalmology have been spoken of as a part of the paraphernalia of the oculist, they have been used with very little system and in an unscientific way.

It is very fortunate that we have in prisms so effective a means of testing for, and treatment of this muscular apparatus.

If I am half right, and what I have done is proved by others to be correct, and these muscular anomalies with their associated syndromes are relieved, there is no greater field for the relief of humanity.

OCULAR TRAPEZE

From Hazen's *New Findings in Ophthalmology and Otology*

To further facilitate the management of these cases, in diagnosis and treatment, I have devised the "Ocular Trapeze," and a Modification of Landolt's Ophthalmodynamometer.

In the former edition of "New Findings," it was recommended that the light (the best is a small frosted electric bulb) be placed on the left side and a little behind the patient, with the patient behind the Kratometer, at a distance of ten or twelve feet from a looking glass, at least the size of 21 by 27 inches, placed on the wall in front. This method of using the light has proved satisfactory. The light is at hand to turn on and off, and

saves considerable expense in appliances, for 20 feet distance, and makes it possible to use a short room and get the proper length.

Then, for examining convergence, the light is in right position, as well as being convenient for making notes in the somewhat darkened room which is the best for this kind of work.

It is necessary to have a black background, and the patient should be free from such surroundings as glass, pictures, or anything that will reflect light and cause confusion with the object light in the looking glass, on which he is to concentrate his gaze.

In order to make the method a still more serviceable one, I have devised this Trapeze, made of 3-8 iron rod in the form of the staple 21 inches inside measurement and long enough to reach from the ceiling to within 5 feet, 7 inches of the floor, and hung by hooks in the end of the rod, into eye hooks, screwed into the ceiling. The rod between the legs of this staple is horizontal and at right angles to the vertical rod.

Fifteen inches above this horizontal bar is another bar running across from leg to leg and parallel to the lower one. Into this space between the bars, a piece of tin, painted black, is hung, so as to easily swing in the space described. Two loops of tin are riveted to the sheet, and form hinges around the lower bar and serve to hold in position, when thrown up between the bars, or let down below the lower one. On this trapeze are rings, one at each of the four corners, and one between the two hinges of the lower bar. The two upper rings enable one to thread a string through to give the vertical movement to the light, for testing the vertical muscles; the ring between the hinges on the lower bar to give the horizontal movement for testing the lateral muscles in case of paralysis of these muscles.



Fig. 6. The author's Ocular Trapeze—a method of examination of the eye muscles.

The patient is seated just in front of the trapeze, before a stand, onto which the Kratometer is fastened. The electric light is hung upon the trapeze, at the left side, behind the patient, and the operator is at his right hand.

In this simple and inexpensive apparatus, the operator has, together with the Kratometer, a complete contrivance by which he can go through all the tests and exercises of the muscles, as well as test vision and detect presence of astigmatism of the muscles, without getting off his stool at the patient's side.

The tests by movement of the light horizontally or vertically placed, which the books describe, to ascertain the muscle paralyzed, are very conveniently performed with this device. The operator has at hand, the other and more modern tests with the Maddox rod, double prism and red glass; he has the light in position for testing convergence and accommodation, and the Von Grafe test for insufficiency; he can hang on this trapeze, the looking glass test type, the lines of astigmatism or the single line to use with the double Maddox prism for test of cyclophoria at a distance, or these may be pasted on one side of the tin—better on the side that faces the glass, when it is put up between the two horizontal bars. He also has the test for cyclophoria at the reading distance.

To obtain a small aperture for testing the muscles, particularly the verticals—a half inch hole may be made in the tin plate, in the left lower corner when let down. A smaller one can also be made in this region if thought best. The electric bulb is hung behind this hole.

The electric light may be held in one hand of the operator to illuminate the letters, and the right hand index finger can point out the letter he wishes named, or by reflectors fastened to the trapeze, the whole surface can be properly illuminated.

Glasses may be fitted with this device, and nearly all the tests, regarding the function of vision, may be performed.

CHAPTER XI

KRATOMETER QUESTIONNAIRE

Q. 1. What is the Kratometer?

Ans. An instrument for the diagnosing of muscular anomalies and treatment of intra-ocular and extra-ocular asthenopia.

Q. 2. What does the word Kratometer mean?

Ans. It is taken from the Latin, meaning measure of strength.

Q. 3. What is meant by intra-ocular and extra-ocular asthenopia?

Ans. Asthenopia is painful vision and intra-ocular is that caused from ciliary and sphincter strain and extra-ocular is that caused from extrinsic muscle strain.

Q. 4. Why is the battery principle scientifically correct?

Ans. The battery principle allows the prisms to completely change from one interval degree to the next causing the lights to separate; inciting the fusion sense to bring them together on the direct pull of the muscles functioning; giving proper stimulation to the nerve centers.

Q. 5. Why is the rotary prism deficient?

Ans. The prism strength is not brought before the eyes on the direct pull of the muscles on account of the rotary movement. The rotary prism gives a drawing sensation to the muscles instead of stimulating and will often strain the nerve centers.

Q. 6. Why is it necessary to have the prism lenses close to the eyes?

Ans. To insure the prism being brought before the eyes on exact axis, eliminating reflections and easier perception of images for fusing.

Q. 7. Why is Kratometer built on a table base?

Ans. So instrument can be set on a table giving absolute rigidity and so the patient can rest the arms on the table giving a complete relaxation essential for the best muscle discipline.

Q. 8. Why are the jumping circular battery prisms essential?

Ans. Moving picture shows, moving objects as seen from cars and trains require a maximum of energy which has to be called on instantly and it is only through these jumping exercises that this essential faculty can be developed.

Q. 9. Why are the eye apertures in the Kratometer made small?

Ans. To prevent the patient from holding his head other than straight, making it possible for them to look through the prism lenses only on exact axis.

Q. 10. Why are the $1/4$ degree prisms so essential?

Ans. The muscles of the human eye are built for speed and not super strength and are very susceptible to strain, so it is necessary to be very careful of trying to force the muscle beyond endurance, especially in the beginning exercises.

Q. 11. Can the vertical muscles be as successfully treated as the lateral muscles?

Ans. Positively yes, with the Kratometer system.

Q. 12. Does the phoria test give you definite information as to the weak muscles?

Ans. No. It only gives you the anatomical tendency of deviation and is very misleading as to determining the weak muscles.

Q. 13. How frequently and for how long should ocular exercises be given?

Ans. Every day if possible, but not less than every other day, until duction powers are up to standard.

Q. 14. What are the standard duction powers?

Ans. Adduction 50 degrees, abduction 8 degrees, sursumduction 3 degrees. Infraduction 3 degrees from standard of orthophoria.

Q. 15. Should the refraction be worn during examination or exercises, and if so, why?

Ans. The correction should always be worn because plus lenses act as a repression and minus lenses act as a stimulant to the binocular faculty. Glasses can be taken off and correction placed in instrument allowing the patient to come closer to the eye cups.

Q. 16. Should exercises be given at infinity (20 ft.), and if so, why?

Ans. Should always be given at 20 feet because on adduction at a nearer point brings the accommodative faculty into play, giving a false duction power.

Q. 17. Why does the Kratometer bring such quick relief of asthenopia of long standing?

Ans. Because you stimulate the nerve centers which are quick to respond; the muscular fibre being fully matured anatomically and simply lacks energy.

Q. 18. Can the use of glasses be discarded by ocular gymnastics?

Ans. Cases that have a fully normal accommodation with slight hyperopic errors will not feel the need of glasses when their adduction power is normal.

Q. 19. Does it make any difference whether the prisms

are all placed over one eye or should they be over both eyes?

Ans. It is preferable in adduction exercises to nearly equally divide the jumping prisms but it really makes no difference because muscular faculties are relation of one eye to the other.

Q. 20. Are Kratometer results permanent?

Ans. Yes. Records of many cases over a period of 10 years have found no relapse except where patient has suffered a general illness such as typhoid pneumonia, etc.

Q. 21. Why are Kratometer ocular exercises so essential to general health?

Ans. The human eye normally consumes 35% of the energy of the body and under maximum strain 80%. Therefore the reflex action due from eye strain causing chorea, hysteria, melancholy and other mental nervous disorders are often entirely relieved with Kratometer gymnastics.

Q. 22. Is the Kratometer essential for good refraction work?

Ans. Positively yes. You cannot determine whether eyes are going to be comfortable with glasses prescribed until you have measured their associate functions of the capacity of the eye to do or to perform any more than you can determine how much a man can smell or hear, by the size of his nose or ears.

Q. 23. What is a good method of service charge for Kratometer work?

Ans. It is best to charge one fee for the complete service depending upon the number of muscles requiring exercise as this will insure patient coming as long as you desire. Decided relief is often attained after a few exercises and if a certain

charge for each exercise is made they will sometimes quit before standard strength is attained and of course are then subject to relapse. A fee of \$25.00 to \$150.00 is in order.

Q. 24. Is exercising of the oblique muscles necessary?

Ans. In very rare cases only. The function of the oblique muscles is more in the nature of balance muscles to maintain an equilibrium and generally the stimulating of the vertical and lateral muscles stimulates the oblique nerve centers sufficiently.

Q. 25. How many exercises are required before patient feels relief?

Ans. As low as five but some instances as high as ten to fifteen treatments. Some patients progress much faster than others.

Q. 26. How do you proceed to exercise cases with diplopia?

Ans. These patients generally have a high degree of imbalance (generally hyperphoria) and correcting prisms are necessary to give binocular vision until the muscle strength is built up to a standard to take care of this diplopia without artificial assistance. The circular batteries are so arranged to throw in the 5 or 10 degree prism base in, out, down, or up for this purpose, a feature not found in other instruments.

Q. 27. When in ocular exercises do you require re-adjusting of the Pupillary Distance?

Ans. In adduction exercises as the prism strength increases and patient fuses the eyes come closer together requiring readjustment of P. D. The Kratometer is so arranged that the patient can readjust at will as required.

Q. 28. Is the Kratometer system based upon a new theory or an active record of experience?

Ans. The Genothalamic Kratometer is a new improved model of instrument, but this system is based upon actual experience of over 25 years. We can refer to either oculists or optometrists who endorse this system as the proper procedure for the treatment of ocular muscles.

Q. 29. Why is it that some specialists do not believe in ocular gymnastics?

Ans. There are two reasons, one, because they have used the rotary prism and found results unsatisfactory and two, because they have let the anatomical position determine the diagnosis of the weaker nerve centers. Both are wrong and misleading.

Q. 30. For what use is the red glass?

Ans. In case your patient has trouble in seeing the two lights on account of the false image disappearing so quickly, place the red glass over one eye which produces one red light and one white light and which can be designated as such.

Q. 31. Why are both the Maddox rod and Maddox prism included?

Ans. The Maddox rod is for examining the anatomical position of the vertical lateral muscles, and the Maddox prism for examining the anatomical position of the oblique muscles.

Q. 32. In what ways are other instruments for ocular gymnastics deficient?

- Ans.
1. The rotary prism draws on the muscle instead of stimulating.
 2. Prism lenses are too far from eyes, making it impossible for the patient to always look through them on exact axis.
 3. Jumping prisms very essential for interval gymnastics are not arranged for.

4. No arrangement for temporary correcting of high degrees of heterophoria in diplopia.
5. Other instruments are not rigid enough.
6. Patient cannot assume a perfectly relaxed position.
7. Very difficult for deflection of prism strength when desiring the assistance of the oblique muscles in ocular exercises.
8. Danger of straining the nerve centers beyond endurance.
9. It is impossible to combine a refraction and muscle instrument together and have efficiency.
10. Relative accommodation and convergence with other instruments are not taken at the natural position for reading.

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CHAPTER XII

Kratometer Procedure for the Diagnosing and Treatment of Muscular Anomalies, Intra Ocular and Extra Ocular Asthenopia.

By A. W. HAZEN

A thorough and complete examination is always recommended and endorsed to Kratometer users, taking plenty of time, giving your patient the service he is entitled to and came to you for; then charge a fee commensurate with your service. If this plan is followed and practiced in each case the success of your practice is assured.

I have sometimes been asked what would be a consistent fee for Kratometer service and on what basis Kratometer work should be charged. I have followed two plans in my practice of charging a certain fee for the entire course of exercises and have charged a fee of \$5.00 for the first examination and \$3.00 for each treatment. I have never charged less than \$25.00 and as high as \$150.00 for the complete service, depending upon the severity of the case found in the preliminary examination and the number of nerve centers requiring attention. It very seldom takes less than ten treatments and sometimes as high as fifty.

I appreciate the fact that the question of fee for service is somewhat out of the line of ethics to discuss on a scientific subject but there are some phases of professional ethics that interfere with sound and practical judgment and reasoning. This is information which you are all interested in primarily, ethics or no ethics, so am simply passing this experience of service charge to you with due apologies.

Results and relief are often very quickly manifested in certain cases, symptoms sometimes disappearing after the fourth or fifth treatment, long before the standard of strength is reached and if your patients are paying so much a treatment they will sometimes quit, thinking it unnecessary to continue. Of course in these cases they are subject to relapse and for this reason it seems a better policy to charge a certain fee for the work, for in this manner you will be more successful in holding your patients and attaining results.

It is very necessary to impress upon your patients that when they undertake ocular gymnastics they must positively agree to come regularly, every day if possible, and not less than every other day, but whatever plan you adopt must be rigidly followed. The writer has made it a practice to not accept these cases without the patients being thoroughly impressed that this work is similar to gymnasium work and unless it is followed regularly they cannot expect results. If you just stop to think that you make no move of any kind without the eye muscles being called into action a hundred times or more, it is perfectly logical and sane, in fact more so, that these muscles be kept in proper training and development the same as our leg or arm muscles. The statement that the eye muscles naturally exercise themselves is just as absurd as to say you require no further than regular routine exercise for the body muscles.

The first preliminary procedure is of course the patient's name, address, age (important), and occupation (very important). The age important not only for refraction data but for the determining of the relative accommodation and convergence, which will be explained fully as we come to that part of our examination. The occupation, both as to business and home life, is very important;

the kind of work he is engaged in; the kinds of lights used; the color scheme of his surroundings, and whether he indulges in reading while lying down. All should be carefully investigated. The writer has often gone over to a patient's place of business for this very purpose and has many times recommended changes that would be beneficial because there are certain color schemes that often produce a very irritating asthenopia when the sun or artificial light is reflected just right. To eliminate such a condition for your patient is a valuable service to him and it insures your service by doing away with a possible re-occurrence of eye strain.

The next procedure is the pathological examination and then the refraction which are very essential and important, but this field is fully covered in other text books, except one feature which is necessary in ocular gymnastics and that is the reserve accommodation, relative accommodation and convergence. It is absolutely necessary that these two faculties function in harmony, or comfortable vision is not attained. Authors have written chapters defining accommodation and convergence while twenty-two words fully explains both as follows: Accommodation is the power of the *eye* (singular) to maintain near vision; convergence is the power of the *eyes* (plural) to maintain binocular near vision. Therefore you can readily see the necessity of these functions being in harmony, and equal in strength and reserve force.

Kratometer users can readily understand and appreciate why a patient can be refracted by a half dozen or more competent men and while no two will agree on the same correction, especially in the spherical error, this same patient can wear anyone of the corrections with comfort. This question can be clearly seen, answered and proven with the Kratometer system because in this case you will find with any one of these glasses that the ac-

commodation and convergence is in harmony, and the intraocular and extraocular faculties are not being used beyond endurance. If this were not the case then the pair of glasses that came the nearest to establishing this harmony of eye function would, in the patient's mind, be the most satisfactory because nature will, up to certain limits, compensate for the balance of the error in correction.

I can make this statement with the greatest sincerity that a person having a poor understanding of refraction but a clear understanding of the intra and extra ocular function will come nearer to being a success than one being an excellent refractionist and neglecting the intra and extra ocular function because nature has a power of compensating for anatomical errors to a large degree. But if that power is weak and deficient with a lack of energy to exert and co-ordinate you have asthenopia (painful vision) and a dissatisfied patient.

Exact refraction and exact understanding of ocular orientation is of course the ideal standard for men of your profession but it is a known fact that too little attention is being paid to these most important details of eye examinaion which in a large measure destroys the confidence of the public in your ability to do what you claim,—to relieve eye strain. You seldom hear of a savage, an Indian, or an illiterate having asthenopia (although they are just as subject to anatomical error as we) but their eyes are used more in the manner and according to the purpose for which nature made them. Present mode in civilization however, forces us to use our eyes to the extreme and therefore the various functions of the eye must co-ordinate and a super reserve power maintained to sustain the eyes in their part through our battles of life with comfortable vision and no injury to general health.

The following table is Donder's table of normal accommodation for emmetropia at the various ages:

Age	Accommodation
10	14 Dioptres
15	12 "
20	10 "
25	9 "
30	8 "
40	6 "
45	5 "
50	4 "
55	2 "
60	1 "

After you have finished your refraction with the correction before the eyes, the No. 1 Snellen reading test type should be brought upon the accommodation rod,—each eye separately, then together to the closest point from which they can read distinctly. For instance, if a patient who is thirty years old can read with his correction on No. 1 Snellen at 5 inches this is normal accommodation. As it takes three dioptres at the average reading distance of 13 inches this patient would then have a reserve accommodation of five dioptres, which would be normal at this age and indicates that your refraction is dynamically correct.

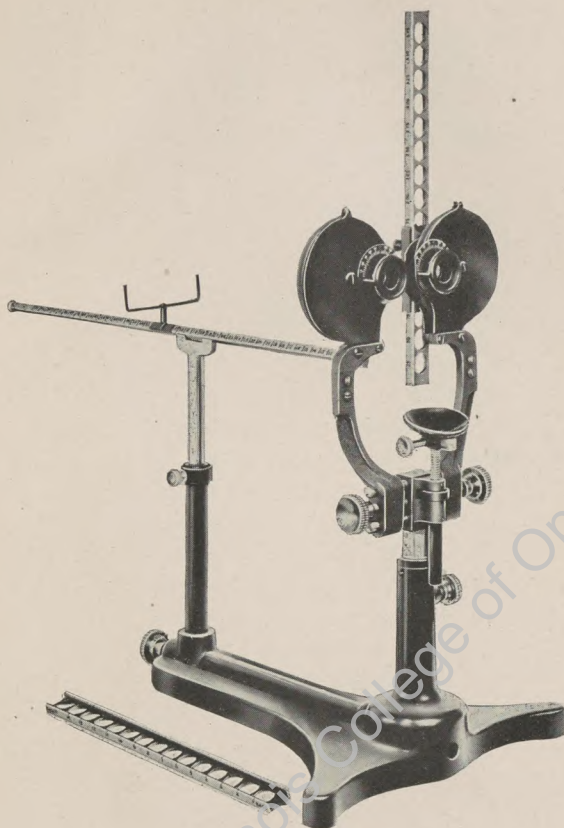
On the other hand if this patient could read a No. 1 Snellen at only 10 inches this would indicate four dioptres of accommodation, a sub-normal capacity or insufficiency of four dioptres. This would prove to you that there was either a latent hyperopia which you had not found or a sub-normal accommodation that would require an increased plus correction (if sub-normal for reading only) or a series of ocular exercises, prisms base out to stimulate or strengthen the third nerve center giving the ciliary greater power to come up to the normal near point of

5 inches, as it should. My procedure would be the ocular exercises first and after this as a rule a slight increase in the static correction will bring the desired results, adding just barely enough plus sphere to your static correction to bring your patient up to the normal near point of 5 inches. These sub-normal accommodation patients are sometimes referred to as premature presbyopes and bifocals in such cases are often advantageous to use in preference to blurring the patient's distant vision.

You must remember, however, that you are dealing with a physical body, therefore the above table must be used with good judgment and you must expect to find exceptions to the rule. These figures are given from a reliable authority and from an average of many thousand cases.

The next procedure is the relative convergence. Von Grafe's method I have found to be the most accurate.

With the refractive correction on or placed in the cells a 10° prism base down is placed before the right eye and the card with a line and dot is placed at the near point of 5 inches with this same patient thirty years old, both eyes before the instrument. The patient will see two dots, one above the other, and if they are both on the same single line your convergence is normal, equal and in harmony with your accommodation. If the upper dot is to the left you have an insufficient negative or sub-normal convergence and the amount of prism base in required to assist the patient to bring the dot over to the line is the degree of sub-normalcy. In these cases we advise care in prescribing plus corrections (as such glasses throw more effort onto an already suffering convergence) until you have given ocular exercises with prism base out, otherwise your patient will experience difficulty in obtaining comfort from his glasses, even



Kratometer—Rear View.

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though your refraction is anatomically correct. Keep in mind that all plus lenses have a tendency to repress convergence and all minus lenses stimulate convergence. This is why you will often find hyperopes wearing minus lenses with comfort because the minus correction stimulates a weak convergence, and while the minus lenses create a still greater artificial hyperopia the active accommodation compensates and nature brings about a near co-ordination of these two functions so that the patient gets relief. If you take this patient and correct the hyperopia as it should be and do not train the converging faculty by ocular exercises (prism bases out) you will have a dis-association of these two functions, convergence and accommodation, that will cause your patient distress and he will invariably declare your work a failure, and justly so.

If the upper dot is to the right of the line you then have a plus, excess or positive convergence, and the degree of prism base out required to bring the dot over to the line is the amount of excess convergence. These findings are indications of strong third nerve centers and unless there is a latent hyperopia it is sometimes necessary to increase the plus static findings to repress this convergence for eye comfort. You can generally prescribe the fullest plus corrections in these cases with no danger of distress to your patient. It has been my experience in these cases that it is better to increase the plus refraction correction than to attempt to over-develop the externi, the sixth nerve center, with prisms base in although some results have been obtained with this procedure.

After investigating and recording thoroughly the history and symptoms of the patient we then proceed to measure the phoria or anatomical position of the extrinsic muscles.

This measuring of the anatomical position has done

more to mislead the refractionist of mistaken identity of ocular weakness than any subject that was ever published on this science.

The phoria examination is a very misleading test unless clearly understood as it is of very little value in real diagnosis and if you will investigate this statement thoroughly and analyze your anatomy and physiology you will readily see how absurd and impractical it would be to allow the phoria or anatomical position determine which muscle or nerve center is deficient.

This is the main feature that has led to the development of the Kratometer system and has been proven beyond any doubt by the examining of thousands of cases that you will find all degrees of heterophoria and orthophoria, both having asthenopia and not having asthenopia. Some of the most severe asthenopic cases on record are those showing orthophoria (perfect anatomical balance) before taking ocular exercises and developing a heterophoria as high as eight degrees yet entirely cured from asthenopic symptoms when the nerve centers were developed to proper standards. As we all know the natural position of rest for the eyes is out (diverging) and the constant tendency of the eyes as they grow tired is to seek the anatomical position of rest (out). We have all had the experience of over-reading late at night and as we get tired and sleepy we begin to see the book or printing double, or you have all seen (possibly not now but in days gone by) a man so drunk that he saw double objects; this is because the eyes give up and try to go back to the anatomical position of rest. Therefore it is an effort even for the eyes to maintain parallelism or orthophoria (perfect balance) and the better the patient felt physically and the earlier in the day he consulted you the more of a tendency to esophoria would manifest itself; if the patient consulted you late in the day when he was

more or less tired out he would manifest more of a tendency to exophoria (the anatomical position of rest). Every time you prescribe a pair of glasses a change in this anatomical balance takes place and it would depend upon what time of day your patient consulted you as to the degree of heterophoria that would be manifested so you might as well try to fly as to try and control the heterophoria or the tendency to anatomical imbalance of the extrinsic muscles.

The phoria should be measured and recorded each day however, for the following reason. The standard of duction powers is always considered from the standard of orthophoria (perfect balance). For instance, if your patient, after a course of ocular exercises, manifested say eight degrees exophoria he would have eight degrees to overcome first before he could start to adduct or converge, which the man with orthophoria would not have to do; therefore his power of adduction should be developed eight degrees higher than the normal standard to put his eyes on an equal and normal basis as to reserve power with eyes showing orthophoria or a perfect anatomical balance. Other than this the phoria test gives you no real or decisive information.

We now proceed with the Maddox rod before the right eye (horizontal position), both eyes being focused upon a muscle light at a distance of twenty feet, glasses to be worn or correction placed in cells of instrument if refraction error exists. If the vertical streak of light is right through the center your patient has orthophoria of the lateral muscles; if the streak is to the right your patient manifests esophoria and the degree of prism with the battery slide base out required to place the streak over the center of the light is the degree of esophoria existing; if the streak of light is to the left of the light exophoria is manifested and the degree of prism with the

battery slide base in required to place the streak over the center of the light is the degree of exophoria existing.

The Maddox rod reversed to the vertical position over the right eye produces a horizontal streak and if it runs through the center, orthophoria of the vertical muscles exists. If the streak is above the light left hyperphoria is manifest and the prism base up to bring the streak over the center of the light is the degree of left hyperphoria. If the streak is below the light right hyperphoria is manifest and the prism base down to bring the streak over the center is the degree of right hyperphoria.

The Maddox prism is then brought before the right eye. Place at a distance of twenty feet a test card with a single straight black line. Looking with both eyes the patient will see three black lines and if all are parallel, orthophoria of the oblique muscles exists in the left eye. If the middle line dips to the right you have a plus left cyclophoria or the left superior oblique is affected. If the line dips to the left it is minus left cyclophoria or the left inferior oblique is effected. Throw the Maddox prism over the right eye back to neutral and bring the Maddox prism of the left eye into position and if the three lines are parallel orthophoria of the oblique muscles exists with the right eye. If the middle line dips to the left it is plus right cyclophoria or the right superior oblique is effected. If the line dips to the right it is minus right cyclophoria or the right inferior oblique is effected.

This same method should also be used at the near point by placing the line at the near point on the accommodation rod at 13 inches, the average reading distance, because frequently a patient will show orthophoria of the oblique muscles at the distance point with a decided cyclophoria at the reading point.

We have now completed our phoria or the anatomical position of the extrinsic muscles and while we know

whether the anatomical relation of the two eyes is normal or abnormal, we have no definite information as to ocular weakness; what to prescribe in the way of glasses for comfort from refractive error we may have found, but we will now proceed to measure each set of muscles as to their power and capacity to act—the real and only definite diagnosis.

Please bear this in mind as this is another of the important features of the Kratometer system found in any other instrument and that is, to find the maximum pulling power of any set of extrinsic muscles does not necessarily mean that this is the strength or full power of the muscle to act. When you are attending a moving picture show, watching a flying machine, or are on a moving car or train where hundreds of objects are seen every minute your eyes have to have the power of a large jumping capacity in order to be called into action in a second's, yes, even a quarter of a second's notice, without undue exertion. It is this principle that condemns the rotary prism as a practical nerve innervator and places the Kratometer system in a sphere by itself and anyone will readily endorse this who has ever used Dr. Hazen's system.

These ocular exercises are referred to as the jumping, quick and instant responding of the fusion sense and is a very important function of the third nerve center which supplies the energy to the internal recti, superior recti, inferior recti—and the Levator Palpebra, extra ocular muscles, the ciliary and sphincter muscles, and intra ocular, so you can readily see the wonderful controlling power of this important nerve center and the wonderful results that can be attained by ocular exercises through this center.

This explains why ptosis (drooping eyelids), sluggish and slow reaction of the pupils served by the sphincter

muscle, and spasms of accommodation can be relieved with ocular gymnastics of the third nerve tract.

The Kratometer system endorses the following duction powers as standard and sufficient for normal eyes and gives a very satisfactory reserve power.

Adduction (power of Internus), 50° eyes in.

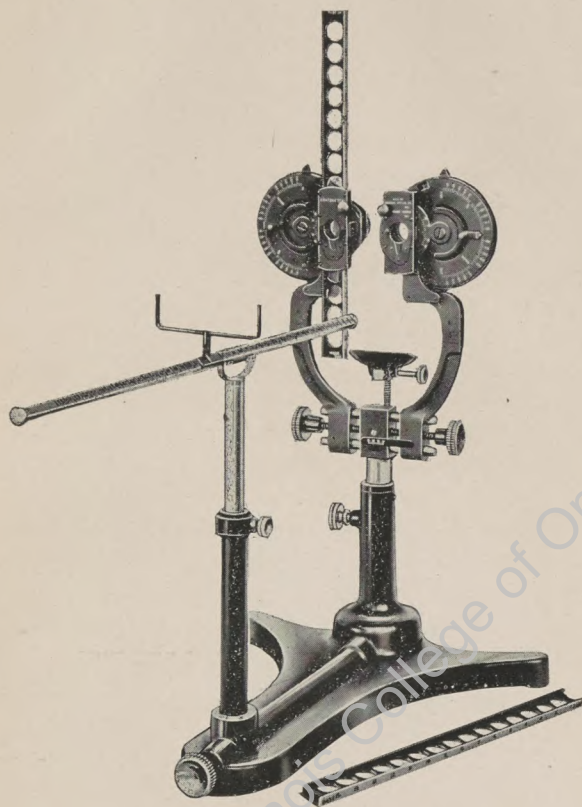
Abduction (power of Externus), 8° eyes out.

Sursumduction (power of Superiors), 3° eyes up.

Infraduction (power of Inferiors), 3° eyes down.

The above are based from a standard of orthophoria (perfect anatomical balance) so if a patient manifests say 8° esophoria his abduction would have to be 16° to be normal in power. These measurements should be taken at a 20-foot distance with refraction always worn, either by the glasses being worn or with correction inserted in the eye cells of the Kratometer.

The adduction power of the internus is measured first with prisms bases out. We first turn on 5 degrees base out over the right eye, the circular or jumping prism battery, and if fusion of the two lights is made quickly we turn on 10 degrees base out, and so on until 25 degrees base out, if the patient continues to fuse the lights. If at 25 degrees the lights are still as one start with the same procedure over the left eye of which there are 5 degree intervals to 25 degrees. If at any time during this procedure the patient sees two lights or is unable to fuse them easily go back to the jumping prism he can fuse and then take the 1 degree interval sliding battery and insert in sliding groove bases out, increasing 1 degree at a time until the patient finds the lights separate and is unable to bring them together. The sum of the degree in the sliding battery and the jumping battery is the power of adduction (strength of internal recti muscles) turning the eyes in. As the adduction power increases, the distance between the pupils decreases and



Kratometer—Front View

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therefore the Kratometer is so arranged that the patient can easily make this adjustment to suit the fusion centers without interference or assistance from the operator.

You will find this experience that a patient will not fuse over 10 degrees in the jumping prisms but when you go gradually 1 degree at a time he will fuse 12 to 15 degrees which proves the former statement that a patient to be normal in interni strength must be able to take any jumping strength up to 50 degrees instantly and without fatigue. We will take up this important phase of ocular gymnastics a little later again as we get into the course of treatment.

We next measure the abduction (power of the externus) with prisms bases in, the circular batteries being turned back to neutral. The power of abduction is more of a faculty to relax the eyes allowing them to turn to the anatomical position of rest and this should be explained to the patient because he will often make an exerted effort, consequently making it difficult for you to make a definite diagnosis.

We use the sliding battery 1 degree intervals running it down in the grooving bringing the prisms before the patient prisms bases in, until lights separate and cannot be fused; turn back to the degree that can be fused and leave in groove.

Then take the $\frac{1}{4}$ degree sliding battery holding with the hand at right angles passing before the eyes bases in in front of the 1 degree sliding battery, starting with the $\frac{1}{4}$ degree, $\frac{1}{2}$ degree and $\frac{3}{4}$ degree, and if the lights still fuse then increase another full degree of battery in groove. By using the $\frac{1}{4}$ degree battery with this method any fractional part of any unit degree can be accomplished bases in with ease and are often very necessary in external ocular gymnastics. The sum of

these two represents the power of abduction (strength of externi recti muscles) turning the eyes out.

We next measure the sursumduction (power of the superiors) with prisms bases down. The circle batteries remain at neutral and the quarter degree sliding battery is inserted in the groove bases down and the same method of procedure is used as with the lateral muscles. The strongest degree the patient can fuse and hold the light single is the power of sursumduction (strength of the superiors) turning the eyes up.

We next measure the infraduction (power of the inferiors) with prisms bases up. The same procedure is used as in sursumduction—the strongest degree of prism base up that the light can be held single is the power of infraduction (strength of the inferiors) turning the eyes down.

While cycloduction is a very rare condition it most generally compensates for itself when proper refraction is made, with proper discipline of the other extrinsic muscles, and can be measured and developed with the Kratometer system as well as the other muscles. The procedure is to use the $1/4$ degree slide battery the same as in infraduction and sursumduction, by deflecting the battery from 90 degrees to the right or to the left, which brings the oblique muscles into action for discipline. The function of the oblique muscles is more in the nature of keeping proper equilibrium or balance in conjunction with the other extrinsic muscles and during the process of treatment with the other extrinsic muscles, which will be explained a little later in Kratometer methods. These oblique muscles with a very seldom exception receive all necessary innervation.

We have now made our complete examination of the human eye and are ready to make an intelligent diagnosis; so as to know what to recommend to our patient. If

we have found a refractive error we can determine with our Kratometer examination whether the glasses are going to be worn with comfort, whether ocular exercises are going to be required for eye comfort, to make the glasses prescribed comfortable. Remember that it is one thing to be able to fit a pair of glasses correctly and another thing to know whether your patient can wear them comfortably. It is this important information which the Kratometer system gives you and which you must know in order to render your patient the best of service and to retain his confidence.

Before we proceed with the treatment of the ocular muscles I wish to impress upon you the following important facts in relation to your refraction work which are valuable and well worth heeding because if you prescribe a pair of glasses without knowledge of the capacity of the eyes to function your patient may experience trouble in eye comfort, although your refraction may be anatomically perfect. His eyes may draw, smart, or he may have a headache after reading a while and if these symptoms do occur he will not always come back to you but will possibly consult another colleague.

Your colleague measures the binocular faculty—the ocular strength of the eyes to perform and by a few exercises brings the eyes into harmony and comfortable vision (your colleague is a success and you are not). Isn't it much better for you to make these measurements so that you will know and then can predict these conditions to your patient, recommend ocular exercises if needed and then if your patient does not take them at once and afterwards experiences this predicted trouble his confidence in you is strengthened, and he returns to you with the feeling of trust—knowing that your advice was correct and honestly given?

One—Where you find hyperopic cases of one dioptré or

more with a minus or negative convergence and a low adduction power, be careful of prescribing full correction before giving internal gymnastics or you can predict eye discomfort as plus lenses repress the converging faculty which adds to the distress of an already weak function.

Two—Where you find hyperopic cases of one dioptré or more with a plus or positive convergence and a strong adduction power you are perfectly safe in prescribing the fullest plus correction because in these cases in Nature's desire to overcome this uncorrected hyperopia it has over-stimulated the internus and the lenses in these cases have two necessary functions; the correction of the anatomical error and act as repression lenses; keeping the accommodative and converging faculties in necessary harmony for comfortable vision.

Three—Asthenopia is not as a rule prevalent with myopia because in these cases the ciliary is inactive and exophoria generally exists, but the procedure as we all know, is to under-correct as far as possible. The duction powers should be kept up to standard as it is my belief that in these cases ocular exercises force the eye from a dormant state into an active eye, inducing proper circulation and prevents myopia from progressing as fast as it would otherwise.

Four—Never prescribe prisms for constant wear except for artificial convergence and then the prism should be on the near point only. To those who have never used this procedure I can say that you are missing one of the best and most important phases of precision refraction work. It is sane and logical that if the accommodation becomes senile and worn out from age your converging faculty which is controlled by the same nerve center and which you will agree is necessary for these two functions to be in harmony and equal in strength for

comfortable near vision is just as old and senile because the same third nerve cannot be young and full of energy for the converging faculty and be senile and worn out for the accommodative faculty.

Also when you prescribe plus spheres for artificial accommodation you not only give no assistance to the already weak converging faculty in many cases, but you antagonize this faculty as plus lenses act as repression and only increase the work of the interni recti for the functions of convergence.

This is why many of you have fitted bifocal lenses and while you know your refraction is correct, your patient cannot wear them on account of the eyes drawing, burning, smarting, and causing headaches after reading a while; therefore many patients on this account give up bifocal wearing as a failure.

The procedure of prescribing for artificial convergence is as follows: After the static refraction and the presbyopic correction is found to bring your patient up to his near point according to Donder's accommodation table at his given age on the accommodation rod of the Kratometer with a No. 1 Snellen reading type, place the card with a line and dot at the same near point with a 10 degree prism base down over the right eye causing vertical diplopia. If the patient sees two dots on one line he does not require any artificial convergence but if the upper dot is to the left of the line the least amount of prism base is required to assist bringing the dot over to the line is the degree of prism that should be prescribed on the reading correction only for artificial convergence. This seems to be a method that few refractionists are aware of, but I have seen cases go the rounds from one man to another and complete relief found in this one little feature of finer refraction work. Some men are not following this procedure today because they think that the

Study

only way a pair of bifocals can be made in this manner is the old style cement bifocal (unless the prism is placed in both the distance and reading—which is worse than none at all) but the Bausch & Lomb Optical Co. can and will manufacture these bifocals in the Ultex style and are the only people to my knowledge, at present, that can or will make them. I do not know just what the additional charge is but it is not large and if you will follow this method your successful results in bifocal work will be most gratifying.

Five—It should be a criminal act for any refractionist to take a child under 15 years of age and fully correct the latent error of hyperopia of an undeveloped eye ball, thereby stunting and preventing the development to a much nearer normal eye ball. Yet when children are put into school and forced, as they are today—often using their eyes more at the near point than older people and where there is a large amount of hyperopia necessary to overcome on account of the eyes not being fully developed—something has to be done to relieve this strain and it should be a method that will not retard the development as nature intended. The static refraction is not necessary in these cases for relief as it is accommodation assistance at the near point only as this is where the child has eye trouble, headaches, etc., (not when he is outdoors playing). In these cases I pay no attention to the static refraction unless it shows a marked astigmatism or sometimes the lower degrees off the horizontal or vertical meridians but I simply place them before the Kratometer, with the No. 1 Snellen reading type at the near point of the given age for normal accommodation according to Donders' table and prescribe just enough sphere to assist them to read this type at that near point. I impress upon the parents' mind that the child is only to wear these glasses when at school or reading and to take them off

any other time. If there is a marked astigmatism for distance I prescribe it—add enough sphere for the near point—giving bifocals and then instruct them to be worn permanently. I instruct the parents to bring the child back in one year and then I use the same method of examination reducing the spherical correction as he grows older until you can eliminate it entirely or largely so—leaving only the static correction if any, and in many cases after the eye balls become fully developed, which is usually at the age of about 18 years, their glasses can be taken off entirely. You will find this method a very pleasing one to parents as they generally abhor the thought of a child wearing glasses all the time or to think of them being worn permanently.

We will now take up the procedure of treating the ocular muscles after determining from our examination what is required.

Gymnastics should be given once a day and better progress will be made if treatments are given at regular intervals, although it will be found that the case will attain to the mark of previous exercise, though a skip of several days may have elapsed. The moral effect and enthusiasm, if kept up will do much in toning up muscular efforts.

Many cases will show slow increase of muscular power for several treatments, until there comes a breaking away of some obstruction, when easier and faster progress will be experienced thereafter.

In sore and tender muscles the lights, when separating will dart apart, the patient having no ability to fuse them. As progress is made, the lights will go apart more slowly and will hang near to each other, and soon the patient will be able to bring them together after they have parted.

It is not best to allow the patient to bring back the light

Study

RX. NO. _____		NAME _____		DATE _____	
PHONE _____		STR. NO. _____		AGE _____	
OCCUPATION: _____		CITY _____		REFERRED BY: _____	

DIST- ANT	O.D.	SPHERE	CYLINDER	AXIS	PRISM	BASE	LENS INSTRUCTIONS
	O.S.						COLOR
ADD	O.D.	SCALE			ON CENTER		SIZE
	O.S.	INSTRUCTIONS			DISPLACED IN		
READ- ING	O.D.						
	O.S.						

MARK CIRCLE AROUND STYLE WANTED BELOW

ULTEX	KRYPTOK	TWIN	CEMENT	EYE GLASS	EYE GLASS	EYE GLASS	SPECTACLES
BI-FOCAL	BI-FOCAL	SIGHT	BI-FOCAL	1 HOLE	2 HOLES	3 HOLES	4 HOLES
		BI-FOCAL		TO PAIR	TO PAIR	TO PAIR	TO PAIR

DRILLING

ABOVE	ON CENTER	BELOW

FRAME OR MTG. INSTRUCTIONS; CATALOG NUMBER;

CHAIN NO

FRAME OR MTG. ENCLOSED	EYE GLASS MTG. NUMBER	BRIDGE NUMBER	PUPILLARY DISTANCE

KIND OF LENSES

TORIC	FLAT	OTHER

SPECTACLES DIMENSIONS	BRIDGE MEASURE- MENTS	HEIGHT	POSITION OF CREST			ANGLE OF CREST
		ABOVE EVEN BELOW	FOR- WARD	EVEN	BACK	
	WIDTH BETWEEN TEMPLES	LENGTH TO BACK OF EAR			TOTAL LENGTH	
EYE GLASS DIMENSIONS	SPREAD OF GUARD		STYLE OF POST	STYLE OF GUARD	STYLE OF SPRING	
	TOP	BOTTOM				

FRAME

RIMLESS	WIDTH AT BASE

ANGLE OF JOINT

MAIL TO PATIENT
YES — NO
WITH—WITHOUT CASE

EXAMINATION

OPHTHALMOSCOPE		
O. D.	O. S.	

OPHTHALMOMETER

O.D.	SPHERE	CYLINDER	AXIS
O.S.			

RETINOSCOPE STATIC

O.D.	SPHERE	CYLINDER	AXIS
O.S.			

RETINOSCOPE DYNAMIC

O.D.	SPHERE	CYLINDER	AXIS
O.S.			

PERIMETER

O.D.			
O.S.			

BLOOD PRESSURE

SYSTOLIC	DIASTOLIC	PULSE

SUBJECTIVE EXAMINATION

O.D.	SPHERE	CYLINDER	AXIS
O.S.			

CORRECTION PREVIOUSLY WORN

O.D.	SPHERE	CYLINDER	AXIS
O.S.			

HISTORY—MEASLES _____ SCARLET FEVER _____ DIABETES _____
DIPHTHERIA _____ VENEREAL _____ TYPHOID _____ PNEUMONIA _____
OTHER _____

SYMPTOMS—

- | | |
|------------------------------------|-------------------------------------|
| SYMPTOMS— | 16—NAUSEA. |
| 1—INABILITY TO FIX EYES ON OBJECT. | 17—RELIEF ON CLOSING EYES TIGHTLY. |
| 2—SLEEPLESSNESS. | OR PRESSING WITH THE HAND. |
| 3—SEASICKNESS. | 18—MELANCHOLIA. |
| 4—CAR SICKNESS. | 19—DEPRESSION. |
| 5—DOUBLE VISION. | 20—IRRITABLE. |
| 6—REDDEN OF EYES. | 21—MENTAL CONFUSION. |
| 7—SWELLING OF EYES | 22—HEART PALPITATION. |
| 8—FILLING OF EYES WITH TEARS | 23—TWITCHING EYE LIDS. |
| 9—PAINFUL STARTING, SHOOTING LAS- | 24—NO HOT SENSATION. |
| ERATING, THROBBING. | 25—EYE LIDS STICK TOGETHER IN MORN- |
| 10—INTOLERANCE OF LIGHT. | ING. |
| 11—INDIGESTION. | 26—MOVING PICTURES IRRITATE. |
| 12—CONSTIPATION. | 27—SPEECH AFFECTED. |
| 13—DIARRHEA. | 28—EPILEPSY. |
| 14—SPEECH AFFECTED. | 29—HYSTERIA. |
| 15—FRIEDHEAD, HEADACHES. | 30—CHOREA. |
| | 31—PTOSIS. |

TREATMENT

[illegible]

MUSCLES	PHORIA	L.H.	R.H.	EXO.	L.C.	R.C.
	ACCOMMODATIVE AT 13 INCHES	WITHOUT CORRECTION			INSUFFICIENCY	RESERVE
		WITH CORRECTIONS			INSUFFICIENCY	RESERVE
	CONVERGENCE AT 13 INCHES	WITHOUT CORRECTIONS			POSITIVE	NEGATIVE
		WITH CORRECTION			POSITIVE	NEGATIVE
	DUCTION TEST	O.D.	ADDUCTION	ABDUCTION	SURSUM	INFRA.
		O.S.				

KRATOMETER RECORD CARD—MUSCULAR DIAGNOSIS AND TREATMENT RECORD

after parting a foot or two. There is some fear of overstraining the muscles. In other cases they must be urged to not allow the lights to part.

Generally the muscular gymnastics have a soothing effect; many experiencing it as having a cooling feeling. A congested condition that has existed for years is often removed after a few treatments.

From five to seven exercises a sitting are generally given. In a few cases of a peculiar type if not too fatiguing, nine to ten may be given.

At each increase of degree of prism if there is still but one light, let the patient say one and when the lights part let him say two. If when there are two, he is not able to bring it back (fuse), gently withdraw the battery and let the patient rest eight or ten seconds.

Some authors put considerable stress on one interni being weaker or stronger than the other and that you should exercise with the prisms over the weaker one. A patient with one eye cannot converge so this function is a relation of the two eyes and while if you measure the adduction with prisms bases out all over one eye, then the other, you will sometimes find a slight contract but this makes no difference. No matter which eye you place the prism over base out you excite the fusion sense of both eyes to the same degree of angle, therefore you give the same amount of stimulation or innervation to each eye. It is possible for a paresis (partial paralysis) of one interni and not the other which would show a marked contrast of adduction measurement but the adduction exercises no matter how the prisms would be divided over the two eyes would bring the desired results.

The Kratometer record card 5x8 in size provides for a complete refraction record, complete pathological record, symptom and history record, muscle gymnastic

examination and a complete record of the daily exercises in detail, on one card. See pages 138-139.

After our examination has been made and we find one or more sets of muscles below standard of strength and the internus are one of these sets we proceed to develop them first to the standard strength of 50 degrees from the standpoint of orthophoria.

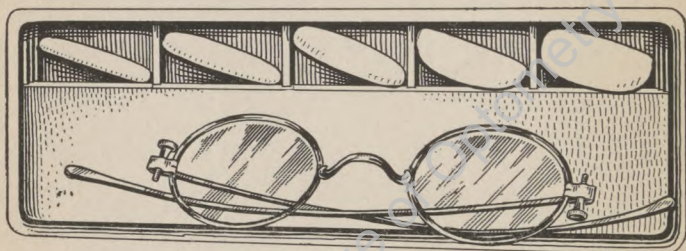
The jumping circular battery prisms are first started over the right eye 5 degrees base out then 5 degrees base out over the left eye and as many of these 5 degree jumps are turned on until the patient says two lights that will not fuse; then turn back to the interval over either eye or both until he says one and insert the sliding groove battery of one degree intervals base out over either eye most convenient for your manipulation increasing each degree until patient says two lights that cannot be fused. The last degree of prism that the patient said one, plus the total degree in the two circular jumping batteries is the total strength of the first exercise to be recorded. The time ordinarily between exercises need be only sufficient to record result.

You will sometimes experience what is termed a block in the nervous energy that acts somewhat like a thrombosis in a vessel which keeps the blood going to and from the heart. The patient will continue to go up to a certain degree for many exercises, sometimes for two or three days and then all of a sudden they will show a sudden jump that appears radical. When you find such a condition a deflecting of the battery to the right or to the left bringing in the assistance of the oblique muscles will often allow the patient to fuse and by gradually turning back to the vertical again they will hold it. This method is often of assistance with the other extrinsic muscles as well.

Remember the jumping power of these muscles, espe-

cially the internus is all important and each day as a final the jumping exercises within the limit of the maximum strength should be practiced and the highest jumping strength should be recorded. When you have attained your standard of internal strength a day or two of jumping exercises should be given by turning on 30 degrees, 40 degrees, or 60 degrees and the patient should fuse them instantly without working up from the lower degrees.

If your patient lives out of the city and is unable to come to your office or say could come in only once a week and still requires interni gymnastics the home prism exercise set is recommended. This set consists of a special straight temple frame with thumb screws, making it possible for the patient to easily change the lenses. It is possible to get any strength of prisms desired from 6 degrees to 36 degrees in the frame and by holding the



balance in the hands over the frame a total strength of 60 degrees base out can be attained. This is an invaluable set for muscle exercise at the patient's home and is only recommended for interni gymnastics.

Abduction—The same process is carried out in procedure. The circular batteries are turned to neutral as they are not used in abduction exercises. The slide battery of 1 degree intervals is used in the groove prisms bases in. When the maximum of 1 degree jumps are reached and the lights are separated, go back to the in-

terval degree that can be fused; then leaving the battery in the groove bring the $1/4$ degree battery at right angles so the $1/4$ degree, $1/2$ degree, and $3/4$ degree can be brought before the eyes in front of the 1 degree battery in the groove. If the last $3/4$ unit is fused then a total 1 degree can be increased with the battery in the groove. In this manner any $1/4$ degree combination can be brought before the eyes and in some cases of weak, deteriorated nerve centers are very essential.

Sursumduction—This is accomplished with the $1/4$ degree battery prism bases down. If when the lights part the battery is deflected, bottom inward, until the patient is able to fuse the light; when this is so, ask the patient to hold it while the battery is slowly brought back to the vertical when it will be generally found that the patient can hold it and another unit of $1/4$ degree can be passed, and sometimes a whole degree, by quarters, can be gained at one sitting. The same procedure of record and exercises as in the lateral muscles is followed in vertical gymnastic work.

Infraduction—The same procedure is followed as in Sursumduction except when deflection of the battery is necessary the bottom turns outward, the $1/4$ degree battery being used with prisms bases up.

Cycloduction—As we have stated heretofore this is very rarely required because by the time the other ocular nerve centers are cared for the obliques have already been sufficiently stimulated for proper tone.

Diplopia—As ocular gymnastics with any instrument cannot be given unless the patient has binocular vision at infinity you will be confronted at times with severe asthenopia cases that cannot even do this and this means that artificial assistance is necessary to give them binocular vision so you can start to strengthen these almost complete depleted nerve centers. These cases are more

prevalent in high degrees of hyperphoria than in the lateral muscles and when necessary to correct this at least partially to assist the patient to binocular vision the 5 degree, 10 degree and 15 degree prism in the circular jumping batteries are so constructed that they can be brought before the eyes in, out, up or down for the purpose of temporarily correcting these high degree heterophorias until the proper innervation can be given these nerve centers to overcome these tendencies of deviation due to depleted nerve centers.

You will find many cases that will not even be able to adduct 5 degrees and that will bring tears to the eyes; a great many 12 to 15 degrees only, abduction 3 or 4 degrees; infraduction and sursumduction very unequal.

In very weak or sore muscles the light will dart away quickly and this is an additional test of severe muscular asthenopia of the muscles.

These muscular asthenopic cases are very poor observers of motion. They will let the lights separate and not observe it. It is necessary frequently to call their attention to this. It is often the case that they will allow the battery to go to the end and will say "one," "one," when they have allowed one light to pass beyond the horoscope.

To catch them, when the last prism of 15 degrees base out in the sliding battery is over the eye, jerk the battery up and out quickly. If they have fused as they should, upon removing the last 15 degrees from the eyes, they should see two lights for an instant, as their eyes are in a position to do so, but of course adjustment comes immediately.

It requires tact and patience in managing these cases, as they have acquired a bad habit of letting things occur before them without noting changes.

The great service of the Kratometer above every other

system of manipulation of prisms, is not only in the steadiness of the movement of the lenses close to the eyes (a most important feature for the best nerve stimulation) but the easy method of stimulation in obtaining quick and almost invariable results are astounding.

As one prominent refractionist states in writing of his experiences: "Besides its money getting value, it is indispensable in satisfying patients. Many times I have used it absolutely free on patients who could not, or would not afford the extra expense of treatments, simply to insure good results from lenses prescribed."

The results are gratifying, are permanent if the procedure outlined is followed to completion.

I can state with the greatest of sincerity that in this great profession of ophthalmology if it became necessary for me to either give up the anatomical and static examination or the physiologic examination under the Kratometer system, I would give up the anatomical and static examination with the absolute confidence that I would come nearer giving satisfaction than vice versa because I would be measuring capacity to do and perform while the man making the anatomical or static examination only would be just like one determining how much a horse could pull by watching him stand still or measuring the power of a street car without turning on the current.

If you men and women desire to aid eyesight conservation and to assist in the nation-wide spirit of keeping the public in the departure from health there is no greater field for progress than the eye because it is a known fact that the eye normally consumes 35% of the nervous energy of the body and under maximum strain they can rob the general nervous system of as high as 80% of the nervous energy of the body so there are no organs so essential to be kept at normal standards for the best general health.

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CHAPTER XIII

CASES OF RECORD

Case 1. August, 1896, Miss M. B., Indianola. Student. Age about 20 years. Deficient in constitutional tone. I had corrected refraction but on returning to study had trouble again; pain of a smarting lancinating character. Orthophoric. Adduction 19° ; abduction 8° . Having exhausted my knowledge on this case, I sent her to Chicago to Dr. Holmes, who found nothing to do but to give gymnastic exercise on the internal recti. The endeavor to carry out this instruction resulted in the first steps of this treatment. In fifteen treatments I brought the recti to the standard, 50° , and discharged her. She remained free from the trouble and was able to prosecute her studies moderately.

Case 2. November, 1896. High school student. Had trouble with eyes since going to kindergarten; remains for hours at a time in a dark room; intolerance of light, especially artificial light; headache about the eyes, could get relief with hot applications. She wore weak cylinders. Vision good, but found it difficult to get clear vision because of blurring or double vision. Esophoria $2\frac{1}{2}^{\circ}$. Adduction 20° . Removed glasses. Treatment. Adduction, 23 treatments, when the esophoria was $1\frac{1}{2}^{\circ}$. Remained in school while treating, and improved from the start. January, 1901, has been free from pain, and only on intemperate use experiences inconvenience. Has not worn glasses since, and has no trouble whatever.

Case 3. January, 1897. W. G. R. Connected with a newspaper and member of the Legislature. I had fitted him with glasses under a cycloplegia, but he was not

relieved. For seven years he had not been able to use his eyes in the evening. In the daytime could use them but two hours, thirty minutes at a time at the most. Eyes smarting and itching and headache. Esophoria, 2° , adduction 5° . In 32 treatments adduction 50° . He used his eyes that winter night and day as any other member of the Legislature. In the winter of 1898, he continued well. He is now the proofreader in a large establishment.

Case 4. February, 1897. Mrs. J. B. D., age about 30. Had an attack of iritis in right eye three years before, which left eyes weak. Had been under good physicians and two oculists. Vision good. Severe lancinating pains and feelings of eye-balls being drawn back, especially at night. On waking in the morning was obliged to rub eyes. Unable to use eyes with any comfort. Esophoria, 10° , adduction, 35° . Treatment, adduction. In 22 treatments was relieved entirely. The winter of 1898 had Lagrippe which seemed to affect eyes somewhat, but did not relapse and remains well. The 10° of esophoria remains in this case.

Case 5. May, 1899. W. H. W. Age about 42. Traveling man. Good constitution and physique; had had neuralgia in and about the eyes for 15 years. Unable to use eyes at near work. Deprived entirely of reading on the cars. Consulted an eminent oculist in Boston, and was wearing a prism prescribed by him, which availed nothing. Examination showed he was emmetropic. Orthophoric. Adduction only 5° . I gave him the Kratometric treatment on adduction daily when in the city, which was broken into sometimes for long intervals and it extended to September, 30 treatments in all. After the fifth treatment he had no more neuralgia, and it never returned. Heterophoria was developed—first exophoria, and then esophoria.

He died from Bright's disease, August 2, 1904, but had no return of eye trouble.

Case 6. May 25th, 1897. Dr. S., age about 35. Addicted to much reading; for three or four years had been troubled with soreness of eyes on reading; eyes hot and dry, feeling of sand under the lids, which would grow worse if reading was continued, and the letters would dance and become blurred, when in a short time, he would be unable to open his eyes. The swollen condition showed itself under the eyes, like the condition often attributed to disease of kidneys. Emmetropic esophoria, 2° ; adduction 5° ; Kratometric treatment of the adductors resulted in attaining 50° in 25 treatments, when all disagreeable symptoms were removed, and he has had no return of the trouble since. In this case, as in many, the heterophoria increased.

Case 7. Miss S. M., Brooklyn, Iowa. Age 23. Graduated from high school with difficulty, having trouble for about eight years. Tried college work and teaching, but had to give them up, and for two years had hardly been able to read a newspaper the length of a finger. Had been fitted and refitted by different oculists; the last one put on plain glasses. She was in fairly good health. She had nearly all the symptoms of asthenopia given under this head. She was unable to look up, or at any moving object without immediately closing her eyes. Her manner had become stiff and eyes red, dull and without animation. Emmetropic. Orthophoric. Adduction 34° ; abduction 9° ; sursumduction $\frac{1}{4}^{\circ}$. Treatment consisted in the duction of every muscle in the orbit. Adduction attained 65° ; abduction 15° ; sursumduction $3\frac{3}{4}^{\circ}$.

By Christmas she was free from pain, attended the theatre without inconvenience and in the next three months read several books without returns of symptoms to any great extent. This case puzzled me under my

own theories and I could get no satisfaction in the theories of the books. (The development of a high standard of strength of the muscles seemed the only treatment indicated.) Examined eyes for error of refraction under a cycloplegia (atropia) and found + :50 hypermetropia. Glasses not recommended.

Case 8. October 9th, 1902. J. C. Lohrville, Iowa. Age 14 years. Had been fitted with glasses four years before. The present trouble commenced in January, 1902. Pain in the eye-balls. Relief on pressure of the eyes. Exophoria 3°; adduction 6°; abduction 8°. In twenty treatments taken in ten days, attained adduction of 60°. Esophoria 10° on conclusion of treatment. She returned home and at once resumed her studies and remains well.

Case 9. December 20th, 1902. Miss N. L. H., teacher. Been troubled five or six years. Constitution good. Been fitted plain glasses and told to persist in wearing them. Inability to fix eye on object; sensation of drawing eyes backward; nervous, sleepless; eyes watering on use; pain in balls of eyes, shooting through; pain on top of head, back and in shoulders. Relief on pressure of eye balls. Esophoria, 1°; adduction, 17°; abduction, 6°. Twenty-three treatments. Adducted, 70°. Took set of four prisms to practice at home. Has been free from pain ever since, and is in much better health and spirits.

Case 10. March 24th, 1903. F. W. Electric line-man, inside work; age about 25 years. Had been under treatment of general practitioner for several months for headache, back and front. For eight weeks it became so severe he had to stop work although it was the busy season. Could not stand on a ladder and, when stooping, black objects came before his eyes. His eyes had that dull look, as if moving the ball was painful. He had no suspicion that his eyes were defective. He was sent to me by his physician to see if there was not some

eye affection. Vision $20/xx$. Emmetropic. Exophoria, 1° . No hyperphoria. Adduction, 12° ; abduction, 7° ; sursumduction, $2\frac{3}{4}^\circ$. Treatment, adduction. After fifth treatment, there was no more pain in the back of the head. When he reached adduction 30° , he went to work and lost no more time. In fifteen treatments, he reached 50° and, after twenty-two treatments, was pronounced cured. He still remains well. He showed esophoria after a few treatments, and quit at $\frac{1}{2}^\circ$ of esophoria.

Case 11. Dr. H., dentist. Age about thirty years. Wore glasses when a boy but not in late years. Had attacks of sudden blindness. Once while playing in an orchestra fell off his chair; was carried home, put to bed and treated for billiousness; there were but few untoward symptoms; some blurring, and a hot feeling of the eyes and pain in temple, but he was generally able to attend to his practice. His physique was extra good.

Emmetropic (manifest) vision $20/xx$ —Orthophoria of all the muscles—adduction 12° to 15° ; abduction 6° . He attained 50° adduction in six treatments. In twenty-two treatments he was pronounced cured. The symptoms did not return, and the two subsequent months, he was found to maintain 50° adduction.

Case 12. July 22, 1904. Age 50 years. Architect. Had been fitted by four or five oculists in this city and Philadelphia. The results of these examinations were about the same, $+1.50$. Very nervous on using eyes; watering of eyes; swelling about eyes; dull drowsy look; dizziness; stomach affected; sickness at and before meals; costiveness; pain in eyeballs, especially in the morning, also in temples. Fingered and pressed on eyeballs a good deal. About to give up profession. Could not go up onto buildings, and drafting became almost impossible.

My examination of the refraction showed about the

same results as found by others. There was a spasm of muscles and examination was not satisfactory.

Orthophoria of both laterals and verticals. Could jump 15° but was slow to adjust when taken away. The exercise caused sickness of the stomach, whenever the highest number he could attain was reached. The light would grow dim but after five or six treatments, the light became clearer and vision on the street improved. In 20 treatments he found that his digestion had greatly improved, and costiveness, for which he had been treated by several physicians, was relieved without medicine. Appetite so much improved that he was apt to overeat.

The esophoria increased under treatment which was mostly adduction, to 14° , but the adduction was uniform in its progress.

At the end of the treatment, there still remained a difficulty in his drafting; the side of the sheet would seem to turn up and form a hollow curve of the sheet. O. D. Astigmatism of $+$.50 was found at an axis of 10° out of the vertical. These glasses, with presbyopic addition, were ample to make him efficient in his severe labors in this very arduous occupation, and the standard has been maintained to the present time without difficulty.

Case 13. August 4th, 1904. Miss J. J. M., age 34. Housework and china painting. Had been fitted under atropia, R. and L. $+$ 1.00 $+$.50 at $180^\circ V^{20/xx}$. Sleeplessness on using eyes. Car sickness. Pain lancinating in balls. Relief on pressure. Had been troubled for two years, and for one and a half years had given up painting. Esophoria 4° verticals orthophoric. Adduction 23° , abduction 7° . Improved fast in adduction. All the extrinsic muscles were treated and responded quickly. So much improved that she ventured to take in the St. Louis fair and did it without detriment. This case increased in esophoria to 14° but the abduction was 9° notwithstanding.

ing, and, in two months, she showed esophoria 8° . She took off her glasses; has painted; kept books, and remains well and, to this time, does not wear glasses.

Case 14. July 24th, 1905. Miss C., age 27. Teacher of drawing. Broke down during study, five years before. Spent two years in Colorado for health and gained 25 pounds. On returning to work lost 20 pounds. A neighboring oculist, on examination under "drops" pronounced, "no glasses needed." She was a slim nervous organization full of ambition. No car sickness but going to church always gave headache. Pain back of head, running down into spine. Relief very quick. No more headache after five treatments. Although attaining to 50° of adduction soon, exercise continued because slow and want of facility of adjustment. Finished in 27 treatments. She gained in weight before end of treatment, and afterwards engaged in active pursuits without relapse.

Case 15. February 6th, 1906. Mr. B. A. C., neighboring city. Age 29. Pharmacist. Has been fitted with glasses by five oculists, one in Chicago, the others in other cities. Tenotomy, three times. Eyes red and angry. Riding or attending theater used him up. Pain, smarting, sticking of eyelids; back of head, temples and shoulders, on pressure of hand, would get temporary relief. Had taken strychnia, and had some prism exercise. Esophoria and some hyperphoria. Adduction 32° , abduction $3\frac{1}{2}^{\circ}$. The adjustments were very slow.

Gave general discipline of all the muscles. With 28 treatments was entirely relieved. Have no report after two months, but up to that time was all that could be desired.

Case 16. March 29th, 1905. Miss B. H., miniature painter. Had spent several years in France and Holland under the best teachers for her art, and opened a studio

Rosen to Tuckman.

in New York City. Became nervous and unable to work—had not thought of the cause being in the eyes at first. But eyeballs became swollen; blurring; pain in the eyeballs, head, temples, extending down spine. Consulted three oculists in New York City. The duction in all pairs of muscles was unusually good. Adduction 40° , abduction 5° . Infra- and sursumduction, $2\frac{1}{2}^\circ$. In two weeks, duction of all muscles was up to standard. Able to read without headache. In one month discharged. Returned to her profession, opened a studio in Chicago, and took the prize for miniature painting at an exhibition in Philadelphia.

Case 17. March 11th, 1906. Canadian. Age about 40 years. Exophoria, 18° . Hyperphoria 18° , L. E. Emmetropia. This case was remarkable for lack of pain. She was wearing 4° , base in over one eye and 4° , base up over the other eye. She could not get along without these on the street, and required $+ 1.25$ D. for near work in addition.

With these prisms, she could adduct 13° and infraduct, $2\frac{1}{4}^\circ$.

In two weeks the lateral prism was taken off and the vertical changed to 2° . In less than two weeks more she became orthophoric in the lateral and adducted 50° , and the verticals $1\frac{1}{2}^\circ$ with a 2° prism. In one month was enabled to go without prisms indoors. At the end of six weeks, she wore a prism of 2° for hyperphoria and a blank for the laterals.

She was unable to continue the office treatment longer. This case was treated by gymnastic exercise alone, no medicine or operation. During the whole treatment, she read and wrote many hours a day. I have not the least doubt but the vertical muscles could have been brought to Orthophoria in another two weeks' treatment and then an occasional attention over a period of three months to

keep them balanced, but she came from a distance and was unable to remain longer.

Case 18. May 31st, 1907. Miss J. D., age 28. Had trouble since 10 years of age. Confined to housework, because she could not keep books for her father, who was a grocer. Was treated for two years, and refracted several times by one of the best oculists in the west. Wearing R. E. + 1.50 + .25 at 180°, L. E. + 1.25 + 25, 170° V. $^{20}/_{xx}$ 20 + $^{20}/_{xxx}$. Carried head to left to avoid diplopia; intense pain if turned to right. Pain in temples, forehead and back of balls and occipit.

Exophoria 10°; adduction 9°; verticals normal. Did not change glasses. In ten days, she adduced 50°. Headache gone. In one month became orthophoric, and remained so while under observation two months subsequently.

She at once commenced studying, and has been able to fulfill her duties since.

Case 19. June, 1908. J. M. M., age 25. R. R. mail agent. Suddenly broke down on duty and was about to resign. Unable to read on train.

Esophoria, 1°. Verticals normal. Adduction, 15°. For temporary use, gave R. and L. + 1.25 D. and treated him when at home. In 24 treatments adducted 50°. He has kept at his duty since that time, and does not use glasses, and is entirely free from apprehension about the eyes.

Case 20. June 16th, 1908. E. M. S., age 37. From a neighboring city. Editor and Postmaster. Troubled with eyes for 15 years. Fitted by oculists with R. and L. — 50 at 180° and changed frequently on both sides of the emmetropic line. Exophoria of laterals, verticals normal. He showed no insufficiency at reading point but could not jump 5° adduction for distance, but by presenting 1° increase at a time could go to 17°, slow

fusing. Was told by former oculist that he must give up his work for six months and take a rest.

This man is of good physique, but very nervous and full of forebodings. Whenever he went home, he would tax his eyes severely in an effort to catch up with his work, which had necessarily been neglected. Notwithstanding, he progressed and attained 60° adduction in 26 treatments, and has not only returned to regular duty, but performed extra duty to catch up back work, and for a short time did not only his own work, but that of his stenographer who went on a vacation. The nervousness has not wholly subsided, unless his inordinate ambition for work is checked, it is to be feared he will break down, but he is going it at full pace at the present time.

Case 21. August 7th, 1908. Wm. McE. Age 44. Traveling salesman. Been troubled 25 years. Broke down suddenly at school. Has been fitted fifteen times by eminent oculists all over the country, east and west. The variation in formula is remarkably slight. Some added prisms. Has worn glasses for twenty years. Wearing R. and L. + .75 at 180°. Lids droop a little bluish of conjunctiva. Had twitching of lids; learned to keep out of crowds; pain at occiput extending down spine. Has had three attacks of sudden blindness.

Exophoria 2°. R, hyperphoria, ½°. Adduction, 25°. Infraduction 1½°. In twenty treatments became orthophoric and duction standard, both lateral and vertical. Reads as much as he wants to—even on cars—no pain and sometimes does away with glasses.

Case 22. September 8th, 1910. Mrs. S., physician's wife and a musician. Age 32. Been troubled since a girl going to school; sick headache once or twice a week; never went to church, amusements or rode on cars, or went into a crowd, without having to pay the penalty of

hours in bed with hot cloths on head. Pain in top and forehead; tender spot occipit and a little to one side.

Fitted 12 years ago in office of one of the best known oculists in the U. S., after going to his office twenty times. Glasses were fitted and changed about a dozen times. She had worn these for 12 years.

There was no particular change in her condition before or since the fitting. Could use her eye for 15 to 20 minutes, but soon had symptoms of headache and sickness. Glasses R. E., + 1.25 + 25. 30°. L. E. + 1.25 X + 20/xxx. Es 3° Verticals orthophoria. Adduction, 7°; abduction 5°; infraduction, 2°; sursumduction 1¼°.

For a month, the duction stood almost without improvement. Either there was no fusion faculty, or the patient did not, from habit, make any effort to use the muscles. I think it was the latter, for, in less than a week she adducted 40°, improving steadily and in two weeks attained 50° and was discharged with 5° of esophoria. Having broken her glasses about this time, she was compelled to go without them, and finding that she got along as well without them as with them, she has not worn them for two months and thinks she does not need them. Is able to do anything she chooses and no return of pain or discomfort.

I have had three cases of pronounced chorea, two of them resulting satisfactorily, but the third relapsed after two years. One, a boy of 12 years was perfectly cured and has used his eyes uncommonly for one so young. Another, a musician has been free from trouble for four years, although he uses his eyes as a musician, playing in an orchestra in a theater. No medicine used.

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